

Academy of Spinal Cord Injury Professionals
Educational Conference 2016
Omni Nashville Hotel and Music City Center
September 4–7, 2016
Presentation abstracts 1–58

1. A LATENT STRUCTURAL MODEL OF HEALTH BEHAVIORS AND PRESSURE ULCERS

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Objective: To develop a latent structural model to demonstrate the relationship between factor structures of health behaviors and current pressure ulcer status among participants with spinal cord injury.

Design: A sample of 2547 participants with traumatic spinal cord injury of at least 1-year duration were recruited from a large specialty hospital in the Southeastern USA, with data analyzed in a Southeastern medical university.

Methods: Multiple latent health behavior indicators were developed, including: (1) alcohol consumption, (2) smoking, (3) unhealthy nutrition, (4) fitness, (5) spinal cord injury health activities, and (6) healthy nutrition. All these latent health behaviors were further linked with a higher dimension classified as risk and protective dimensions. Dichotomized current pressure ulcer status was included as the main outcome measure. Latent variable structural equation modeling was performed to assess the relationship between health behaviors and current pressure ulcer status.

Results: The model fit indices for the hypothetical model were acceptable for the suggested level ($\chi^2=2054.547$, $df=267$, $\chi^2/df=7.69$, $P<0.0001$, root mean square of approximation=0.051, comparative fit index=0.919, Tucker Lewis index=0.909). The protective behavior dimension had a significant direct effect on current pressure ulcer status (direct effect= -0.581 , $P=0.01$). All indirect effects of healthy behaviors (fitness, spinal cord injury health activities, and healthy nutrition) on pressure ulcer via the protective behavior dimension were also significant. Alcohol consumption, smoking, and unhealthy nutrition had significant direct effects on the risk behavior dimension but insignificant indirect effects on current pressure ulcer status through the risk behavior dimension.

Conclusions: The overall findings of this study suggest the need to enhance healthy behaviors and reduce risk behaviors to prevent pressure ulcers among people living with spinal cord injury.

Financial Support: The contents of this presentation were developed under grants from the US Department of Health and Human Services Administration for Community Living, NIDILRR grant numbers 90RT5003 (NIDRR # H133B090005). However, those contents do not necessarily represent the policy of the Department of Health and Human Services, and you should not assume endorsement by the Federal Government.

2. A PICTURE IS WORTH A 1000 WORDS: THE POTENTIAL OF DEFINING INCOMPLETENESS OF INJURY WITH NEUROIMAGING AND BRAIN NEUROPHYSIOLOGY

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Objective: To determine if neuroimaging or neurophysiology can more objectively define incompleteness of injury and predict impairment/recovery potential in comparison to the AIS scale.

Design: A longitudinal design across patients undergoing rehabilitation (NCT01539109).

Participants/Methods: Eight male patients with chronic incomplete spinal cord injury (SCI) were enrolled. We defined incompleteness of injury in patients using diffusion tensor imaging (DTI/MRI) and transcranial magnetic stimulation (TMS). For DTI/MRI, incompleteness was defined by the amount of demyelination and axonal loss in the corticospinal pathways. For TMS, incompleteness was expressed as the difference in excitability of corticospinal pathways devoted to a muscle located above and below injury. All patients received rehabilitation for the paretic upper limbs for 5 days/week for 2 weeks. At pretest and from pretest to posttest, we assessed AIS grade and functional outcome measures. Linear regressions were used to determine if incompleteness of injury was related to baseline or the change in functional outcomes with rehabilitation, significance was defined as $P < 0.05$.

Results: We found that incompleteness of injury as defined by DTI/MRI and TMS was related to baseline clinical impairment, wherein those with a less incomplete injury demonstrated a poorer UEMS ($r = 0.66$, $P < 0.05$) and reduced hand function ($r = 0.5$, $P < 0.03$). In contrast, AIS grade was only related to baseline UEMS ($r = 0.75$, $P < 0.03$). We also found that incompleteness of injury defined by DTI/MRI and TMS could significantly predict the level of recovery in patients with two weeks of rehabilitation. Specifically, patients that demonstrated the most recovery had a more incomplete injury ($r = 0.97$; $P < 0.0001$). In comparison, AIS grade showed poor relationships with recovery ($P > 0.2$).

Conclusion: Current classifications of incompleteness of SCI are unable to identify mechanisms of recovery or recovery potential due to large within-category variability (e.g. AIS grade). Two powerful tools that may provide a more objective insight are TMS and DTI/MRI. Here, we have found that incompleteness of injury defined with TMS and DTI/MRI can more significantly relate to baseline function and the level of recovery after rehabilitation in comparison to the AIS scale. Collectively, our results suggest that DTI/MRI or TMS may serve as a more powerful tool than standard clinical examinations to define incompleteness and predict baseline function or recovery potential after SCI.

Financial Support: Work was funded by DoD W81XWH1110707.

3. BORS AWARD WINNER: A RETROSPECTIVE REVIEW OF SAFETY USING AN INPATIENT AUTONOMIC DYSREFLEXIA PROTOCOL FOR PATIENTS WITH SPINAL CORD INJURIES

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Objective/Background: Autonomic dysreflexia is a potentially life-threatening condition which afflicts a significant proportion of individuals with spinal cord injuries (SCI). To date, the safety and efficacy of several commonly used interventions for this condition have not been studied.

Design: A retrospective chart review of the safety of a previously implemented nursing driven inpatient autonomic dysreflexia protocol.

Methods: Seventy-eight male patients with SCI who experienced autonomic dysreflexia while inpatients at our Veterans Affairs SCI unit over a 3.5-year period were included. The safety of a nursing-driven protocol utilizing conservative measures, nitroglycerin paste, and oral hydralazine was evaluated.

Outcome Measures: Occurrence of adverse events and relative hypotensive events during all episodes treated with the protocol, and efficacy of attaining target blood pressure for all episodes with protocol adherence and for initial episode experienced by each patient.

Results: Four hundred forty-five episodes of autonomic dysreflexia were recorded in the study period, with 92% adherence to the protocol. When the protocol was followed, target blood pressure was achieved for 97.6% of all episodes. Twenty-three total adverse events occurred (5.2% of all episodes). All adverse events were due to hypotension and only 0.9% required interventions beyond clinical monitoring. Of each patient's initial autonomic dysreflexia episode, 97.3% resolved using the protocol without need for further escalation of care.

Conclusion: This inpatient nursing-driven protocol for treating autonomic dysreflexia utilizing conservative measures, nitroglycerin paste and oral hydralazine achieved target blood pressure with a high success rate with a low incidence of adverse events.

4. ADIPOSE TISSUE RELATES TO GLUCOSE METABOLISM AND PROINFLAMMATORY CYTOKINES BY LEVEL OF SPINAL CORD INJURY

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Objective: Level of injury (LOI) and the contribution of visceral (VAT) and subcutaneous (SAT) adipose tissue (AT) to metabolic dysfunction following SCI remains a current area of investigation. Current research recognizes AT as an endocrine organ releasing proinflammatory cytokines that can modulate glucose homeostasis. The aim of this investigation was to characterize the relationship of AT with glucose metabolism and proinflammatory cytokines by LOI in SCI.

Design: Cross-sectional and correlation; Clinical hospital and academic setting.

Methods: Forty-three chronic motor complete C5–L2 (ISNCSCI A&B) individuals were included (M/F 36/7, age 42.7 ± 10.5 [range 18–65], BMI 26.0 ± 6.0). Participants were classified according to their LOI as either tetraplegic (C5–C8; n=11) or paraplegic (T2–L1; n=32). Participants were excluded if unable to hold their breath for 20 s, had spinal fusion, pressure ulcers > grade 2, uncontrolled spasticity, thyroid or renal disease, or autonomic dysreflexia. All participants underwent an intravenous glucose tolerance test to calculate glucose effectiveness (Sg), insulin sensitivity (Si), and laboratory assessments, including serum levels of fasting plasminogen activator inhibitor-1 (PAI1), high sensitivity c-reactive protein (CRP), interleukin-6 (IL6), tumor necrosis factor alpha (TNFa), and tumor necrosis factor inhibitor 1 (TAFI1). VAT and SAT were quantified using noncontrast magnetic resonance imaging. Assays and images were analyzed according to previously published methods.¹ Images were separated into VAT and SAT and a VAT/SAT ratio was calculated. Spearman correlations were used to evaluate relationships with a <0.05 .

Results: In participants with tetraplegia, VAT correlated with TNFa ($\rho=0.65$, $P<0.05$), while SAT correlated with Sg ($\rho=-0.54$, $P<0.05$), both VAT and SAT correlated with PAI1 ($\rho=0.47$, $P<0.001$ and $\rho=0.44$, $P<0.05$, respectively), while VAT correlated with Si ($\rho=-0.47$, $P<0.001$) and CRP ($\rho=0.32$, $P<0.05$) in participants with paraplegia.

Conclusion: The current results show that LOI influences the relationship between AT depots and proinflammatory cytokines. These findings may help explain the observed differences in body composition and metabolic profiles between individuals with tetraplegia and paraplegia. These relationships warrant further research to see if intervention modulates the observed results.

Financial Support: VHA RR&D B6757R and NIH UL1RR031990

5. ASSESSING BLADDER-RELATED QOL AFTER SCI: A PCORI STUDY PROTOCOL

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Objective: The Patient-Centered Outcomes Research Institute (PCORI) funds research with the goal of providing patients with “information they can use to make decisions that reflect their desired health outcomes.” Neurogenic bladder (NGB) management is a significant daily consideration in lives of patients after spinal cord injury (SCI). Our aim was to design a multicenter longitudinal study to help describe quality of life (QoL) factors related to NGB after SCI.

Design: Preparatory phase for a multicenter longitudinal research study.

Participants/methods: Collaborative multicenter prospective research protocol developed by investigators, patient and clinician stakeholders

Results: Systematic literature review identified 3 Patient-Reported Outcome Measures (PROMs) addressing NGB in SCI. Patient stakeholders were selected from the primary investigators' clinical practices. A patient advisory meeting was held with SCI patient stakeholders who participated in a facilitator-led semi-structured qualitative group discussion about NGB management and QoL. The patient stakeholders also reviewed potential PROMs for inclusion. Themes identified in this discussion were used to select specific question banks. Patient, clinician and investigator stakeholders met to finalize PROMs and database content. An anticipated 900 study participants will complete the question banks (Neurogenic Bladder Symptom Score, selected SCI-QoL item banks, Neurogenic Bowel Score, pain scale, autonomic dysreflexia questions and modified SF-12). In order to engage a diverse demographic and enroll remotely, the study is advertised via nbrg.org, social media, rehab facilities, urology clinics, national SCI advocacy groups & SCI-centered events. After eligibility screening (SCI & ≥18y/o) and consent, participants undergo a 20-minute interview to document prior history. PROMs questionnaires are then completed electronically at baseline, 3, 6, 9 & 12 months. Extractions from participants' electronic medical records include hospitalizations, lab and radiology results. Repeated-measures analyses will be performed on data to assess change from baseline through 12 months with planned subgroup analyses to include specific SCI populations and participants that have changed bladder management over the year.

Conclusion: This multicenter longitudinal research study has been developed following the guidelines specified by PCORI to ensure prioritization of all stakeholder interests and optimize patient-centeredness.

Financial Support: PCORI CER14092138

6. BODY MASS, METABOLIC, AND CARDIOVASCULAR IMPACT OF PRESCRIBED AQUATIC EXERCISE AND NUTRITIONAL GUIDANCE FOR INDIVIDUALS WITH CHRONIC MOTOR INCOMPLETE SPINAL CORD INJURY (CMISCI): A CLINICAL CASE SERIES

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Objective: To assess dosed group aquatic exercise at 70–75% of heart rate reserve (HRR) and nutritional guidance upon body mass, glucose, insulin, A1C, peak VO₂, and resting metabolic rate (RMR) for three individuals with CMISCI and fasting glucose greater 100 mg/dL.

Design: Pilot study, clinical case series.

Participants/methods: Three men: 63-years-old, AIS D, body mass index (BMI) 31.9; 34-years-old who is non ambulatory, AIS C, BMI of 31.6; and 58-years-old, AIS D, BMI 27.4. We prescribed dosed aquatic exercise program 3 times per week for 10 weeks, and a weekly phone nutritional consult by phone. Nutritional guidance included reducing refined carbohydrates and processed food, limiting high glycemic fruits, and increasing vegetable, fluid and lean protein intake. Outcome measures (pre/post) included: three-day electronic food logs, weekly hard copy food logs, glucose, insulin and A1C (via standard fasting venipuncture), peak VO₂ and RMR.

Results: Participant one decreased glucose, 20% (132 to 106 mg/dL); A1C, 11% (6.3–5.6); weight, 10%, (11.9 kg); RMR, 13%; and peak VO₂, 12%; participant two increased glucose, 9%; A1C, no change; decreased weight, 3% (3.3 kg); decreased peak VO₂, 18.5 RMR, 4.5%; participant three decreased: glucose, 14%, (126 to 108 mg/dL); A1C, 5% (7.5 to 7.1); weight, 6% (88.9 to 83.8 kg); and increased peak VO₂, 8% (21.9 to 23.7) and RMR, 12.5%.

Conclusion: Moderate exercise with weekly nutritional guidance decreased body mass, glucose, and A1C in two out of three CMISCI individuals. Further examination of the impact a low cost intervention of combined aquatic exercise with nutritional guidance exerts upon body mass, metabolic status, and cardiovascular fitness for individuals with CMISCI is indicated.

Financial Support: Aquatic Section, American Physical Therapy Association.

7. BUILDING POSITIVE WORKING RELATIONSHIPS BETWEEN PEOPLE WITH SCI AND CAREGIVERS

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Objective: To present suggestions for fostering positive interpersonal dynamics between people with spinal cord injury (SCI) and their caregivers identified in discussions with people with SCI, caregivers, and SCI clinicians.

Design: Qualitative analysis of data acquired through focus groups.

Participants/Methods: Focus groups were conducted with people with tetraplegia due to SCI who have experience directing their care (n = 26), family and/or hired caregivers (n = 13), and SCI clinicians (n = 25) as part of a larger project whose objective was to create an assessment tool for direction of care/caregiving skills. Discussion topics included learning to direct and provide care, characteristics of good direction of care and caregiving, suggested topics for training and other related experiences. Recordings of the discussions were transcribed and imported into NVivo for coding by primary and secondary themes. Interpersonal dynamics emerged as a key theme. Subthemes that discuss suggestions for promoting positive working relationships between caregivers and people with SCI are presented here.

Results: Key suggestions included: (1) Set and document expectations early in a collaborative process that involves both the person with SCI and caregiver. (2) Explain not only WHAT needs to be done, but WHY to avoid the perception of being “picky” and to give respect to the contributions caregivers make to health and function. (3) Respect each other’s expertise. (4) Acknowledge when things do not feel right so that a solution can be identified early. (5) Be flexible and open to collaboratively finding new ways of doing things. (6) Periodically step back and re-assess the big picture of how the dynamics feel to identify areas for improvement or strengths to cultivate. (7) Treat one another as you would like to be treated.

Conclusion: Interpersonal dynamics play a key role in the success or failure of the care experience. Through trial, error, and experience, people with SCI and their caregivers have identified strategies for promoting mutual respect and successful collaboration. Findings from this investigation will inform the development of consumer education materials to promote positive relationships.

Financial Support: This research was supported by the Department of Defense Spinal Cord Injury Research Program under award number W81XWH-12-1-0553. Views and opinions of, and endorsements by, the authors do not reflect those of the US Army or the Department of Defense.

8. BUILDING RESILIENT FAMILIES: COPING WITH CAREGIVING BURNOUT IN SCI

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Objective/Rationale: Spinal cord injury (SCI) often results in physical limitations such that receiving assistance from others is critical to maintaining health and facilitating full societal integration. The help received ranges from assistance with basic daily activities such as bowel and bladder management, bathing, hygiene and dressing, to instrumental activities of daily living, including managing household finances, shopping, or transportation. Caregiving, while at times rewarding, can place significant demands on an individual's coping mechanisms.

Design: Qualitative study involving focus groups with family caregivers of veterans and civilians with SCI.

Participants/methods: One hundred thirty-three family caregivers participated in one of 28 focus groups around the USA. Participants were asked to discuss the positives and negatives of caregiving, their sources of strength, life changes they have experienced, and the effect of caregiving on their own health.

Results: Positive themes included changes in self-awareness, greater closeness of the family, feeling appreciated and having increased compassion toward others. Negative themes were predominant and included having a lack of time for oneself, physical and emotional exhaustion, lack of support from others, dissatisfaction with hired caregivers and agencies and strains on family relationships. Participants reported that they drew strength from their faith, family and friends. Life changes were related to employment, finances, travel and leisure and having to move or modify the home. Health issues identified by the participating caregivers included physical pain and injury, having their own illnesses and disabilities, fatigue, sleep deprivation and depression. Each of the themes will be highlighted by quotes from the participants to better illustrate the issues related to being a family caregiver. Strategies to address negative experiences include counseling both during the rehabilitation process and in the years following discharge, as caregivers often cannot anticipate difficulties once they bring their family member home.

Conclusion: Although there are positive aspects to being a family caregiver, most caregivers experience a wide variety of stressful situations that negatively impact their lives. Strategies from clinicians are needed to identify problem areas for family caregivers and help minimize negative outcomes.

Financial Support: National Institute on Disability, Independent Living, and Rehabilitation Research, Grant #H133G090013; Department of Defense Grant #W91ZSQ113N605

9. BURDEN AMONG CAREGIVERS OF ADULTS WITH SPINAL CORD INJURY

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Objective: Enhance our understanding of the caregiver experience by exploring caregiver quality of life (QOL) in the context of caring for adults with spinal cord injury (SCI).

Design: Cross-sectional mixed methods (qualitative and quantitative) study.

Participants/methods: Twenty dyads were enrolled from four rehabilitation hospitals in or around one large urban area (20 adults with SCI; 20 caregivers, three adults with SCI were veterans (15%)). Adults with SCI were injured at an average age of 21 years (Range 17–37), were currently between 26–53 years of age (M=37.12 years, SD=6.47); 75% had tetraplegia, 60% were injured in transportation accidents. Caregivers were an average of 49.23 years old (SD=16.35, Range=22–77), were mostly Caucasian (55%), female (75%), high school educated

or higher (80%); and were a spouse or significant other (40%), parent (45%), sibling (10%), or other relative (5%) to the adult with SCI. The current study combined the strength of standardized quantitative measures of caregiver burden, QOL, and social support with in-depth interviewing about the caregiving relationship and caregiver's role, preparation and support for caregiving, QOL and unmet needs.

Results: Overall, caregivers appeared healthy and satisfied in their roles. However, quantitative measures indicated that ten caregivers (50%) appeared to have "red flags" or challenges related to at least one area of concern (QOL, amount of leisure time, physical health, mental health, or social support) and such flags were related to higher caregiver burden scores ($r=0.54$ $P<0.05$). In addition, adults with SCI were more likely to report higher anxiety from dyads with higher caregiver burden scores ($r=0.45$, $P<0.05$). All caregivers qualitatively shared a variety of unmet needs related to physical and emotional stamina, self-care and socialization.

Conclusion: These data suggest the need to raise awareness of the importance of caregiver burden and launch initiatives to bolster caregiver physical and emotional health including self-care and connections with others.

Financial Support: Department of Defense (Grant #SC130279)

10. CHARACTERISTICS OF LIMB LOSS FOLLOWING SPINAL CORD INJURY: A RETROSPECTIVE CASE SERIES

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Objective: To determine characteristics of limb loss following spinal cord injury (SCI).

Design: Retrospective case series

Methods: Procedure codes were used to identify all individuals receiving care from a Veterans Affairs SCI Service who underwent amputation surgery at the hospital between 2000 and 2015. Medical records were reviewed to identify comorbidities, indications for lower limb amputations, functional changes following amputation, and mortality.

Results: Over 15 years, 52 individuals with SCI underwent lower limb amputations. The mean patient age was 62.9 years (± 12.1), mean injury duration was 17.1 years (± 13.5), and all patients were male. Level of injury was cervical for 15 (28.8%), thoracic for 26 (50%), and Lumbar for 11 (21.2%). American Spinal Injury Association Impairment Scale was A: 19 (36.5%), B: 15 (28.8%), C: 7 (13.5%) and D: 11 (21.2%). Common comorbidities included hypertension (61.5%), peripheral arterial disease (PAD) (48.1%), diabetes (42.3%), and cardiac disease (34.6%). The majority of amputation levels were transfemoral (55.8%) followed by foot amputations (17.3%), transtibial (15.4%) and hip (11.5%). Almost 60% had chronic ulcers, and 50% had osteomyelitis as indications for surgery. Twenty-three (44.2%) had had prior amputations, of which 10 (43.5%) had amputations on the same side.

Functional Independence Measure (FIM) transfer sub-scores declined significantly ($P=0.004$) between pre-amputation and one year post-amputation. Nine (17%) ambulated for short household distances with assistive device prior to amputation, and 7 (13%) remained ambulatory after surgery. Survival was 86%, 74%, and 52% at 1, 2, and 5 years post-amputation, respectively, and mortality was associated with PAD ($P=0.005$) and cervical level ($P=0.023$).

Conclusion: In this case series, amputations were most commonly performed for definitive management of chronic ulcers and osteomyelitis. Transfemoral was the most common level of amputation. PAD was prevalent and associated with mortality post-amputation.

Financial Support: VA Puget Sound Health Care System

11. EFFECT OF NATIONAL VETERANS WHEELCHAIR GAMES ON EMPLOYMENT STATUS OF DISABLED VETERANS

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Objective: To determine whether participation in the National Veterans Wheelchair Games (NVWG or Games) positively influence employment outcome in persons with disability.

Design: Prospective, cross-sectional study

Participants/methods: Veterans who participated at the 2015 NVWG were given the opportunity to fill out a two-page, eight-questionnaire survey. The following data were obtained: age, sex, type of disability, year of injury, years of participation in the Games and employment status before the injury, before participation in the Games, after participation in the Games. Additionally, veterans were asked how participation in the Games has helped them to seek employment if applicable.

Results: Of the 338 veterans participating in the study, 32% of those who participated in the survey were employed (working, volunteering, or both) at the time of the survey. Of the veterans who attended the 2015 NVWG, those who were currently employed were 3 times more likely to say that the games had a positive effect on employment than those who were not currently employed ($P=0.001$). Additionally, veterans who felt that the Games had a positive effect on employment had attended 3 more wheelchair games on average than those who felt that the Games did not have an impact on employment ($P<0.0001$). Positive responses were obtained from the Likert scales that asked how the Games helped to seek employment.

Conclusion: The results presented in the study showed that those who were currently employed at the time of the study or have been participating in the Games for 3 or more years were more likely to say that attending the Games helped them to pursue employment. No significant differences were noted in the responses regarding how attending the Games achieve employment. In general, these findings suggest that participating in the Games provide some psychosocial support (self-esteem, morale, networking/bonding) and may have a positive influence in employment outcomes.

Financial Support: A \$2,500 research grant was approved by the Paralyzed Veterans of America—Wisconsin Chapter (WPVA RG #100).

12. ESSIE MORGAN LECTURE: ENVISIONING PRECISION MENTAL HEALTH TREATMENT FOR DEPRESSION AFTER SCI

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Purpose: To improve the systems of care for depression after spinal cord injury.

Brief background of issue/topic: Approximately one quarter of people with spinal cord injury are affected by depression. Depression is associated with poorer health, rehabilitation, and quality of life outcomes in SCI. Under current standards of care, depression after SCI is undertreated. A growing body of research can be used to envision “precision mental health care” for depression after SCI. Longitudinal research is revealing distinct trajectories of depression and emotional resilience. Mental health history and other baseline predictors of trajectories can be used to determine who needs active surveillance or treatment. Higher-quality intervention research is being carried out and will hopefully broaden the list of efficacious treatments. Research on risk factors and treatment preferences may guide decisions about which treatments will be most effective and for whom. Health services research concepts such as measurement-based treatment, treating-to-target, decision support, stepped care, and collaborative care are promising approaches to delivering more effective mental health care once treatment has begun. Tele health and other alternative intervention models can overcome geographic and other barriers to effective service delivery.

Significance for SCI practice: Creating more effective, targeted systems of care to reduce depression after SCI could improve health, rehabilitation, and overall quality-of-life outcomes for people with SCI.

Conclusion/Summary statement: Elements of a more evidence-informed approach to managing depression after SCI are emerging and can be used to improve treatment targeting and effectiveness now as well as to guide future research.

13. EVALUATION OF THE WALKING INDEX FOR SPINAL CORD INJURY II (WISCI-II) IN CHILDREN WITH SPINAL CORD INJURY

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Objective: The Walking Index for Spinal Cord Injury II (WISCI-II) is a performance measure evaluating walking capacity. It is recommended for adult spinal cord injury (SCI) clinical trials but has not been fully evaluated for use with children with SCI. The purpose of this study was to evaluate inter- and intra-rater reliability of the WISCI-II in children with SCI and to examine the concurrent validity between the WISCI-II and the Spinal Cord Independence Measure-III (SCIM-III) item #12 (indoor mobility up to 10 meters).

Design/Method: This was a repeated measures design using a sample of convenience. Ambulatory children with SCI were evaluated using the standardized testing procedures for the WISCI II on two repeated occasions by the same therapist to examine intra-rater reliability. The first trial was photographed and de-identified. Each photograph was reviewed and scored by 4 physical therapists to examine inter-rater reliability. The SCIM III was administered via interview. Inter- and intra-rater reliability of the WISCI-III scores were calculated using Interclass Correlation Coefficients (ICCs) with 95% confidence intervals (CI) and the concurrent validity between the WISCI-II score and SCIM-III item #12 was evaluated using Spearman Correlation Coefficient (rs).

Results: Forty-seven children with a mean age of 9.1 (range, 2–17), a diagnosis of tetraplegia (n=12) or paraplegia (n=35), and AIS classifications of A (n=3), B (n=2), C (n=8), D (n=14), and unknown due to age (n=20) completed repeated measures of the WISCI-II and SCIM-III assessments, and 40 de-identified photographs were obtained and scored by physical therapists. Intra- and inter-rater reliability was high (ICC = 0.99, CI = 0.993–0.998 and ICC = 0.97, CI = 0.95–0.98 respectively). The correlation between the WISCI-II and the SCIM #12 was moderate (rs = 0.43, P=0.0023).

Conclusion: This study demonstrates support for use of the WISCI-II in ambulatory children with SCI.

14. EXPERIENCE OF USING PHOTOVOICE, IN INDIVIDUALS WITH SPINAL CORD INJURIES/DISORDERS

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Objective: There is a need to engage persons with spinal cord injuries and disorders (SCI/D) in research methodologies that go beyond traditional approaches because they offer insights into the patient context that are not easily gathered by traditional methods, and help to guide health care and service delivery that is directed by what matters most to the individual/patient. Participatory methods, such as photovoice, empower individuals to share their perspectives through photographs and narrative. The objective of this study was to examine

the use of the photovoice methodology in a cohort of persons with SCI/D and to describe feasibility, and their experiences with photovoice, including both rewards and challenges.

Design: Photovoice, which included participants taking photographs that captured salient features in their environment guided by prompts about barriers and facilitators to function followed by in-person, in-depth interviews to collect narratives stimulated by the photographs.

Participants/methods: A convenience sample of Veterans with SCI/D was recruited via flyers distributed and posted in the Spinal Cord Injury Center (SCI/D Center) and given to SCI/D health providers to disseminate. Analysis. Interviews were audio-recorded and transcribed verbatim. An inductive coding approach was used to derive and finalize key themes.

Results: Key themes revealed included: 1) function, 2) participation, 3) individual context, 4) quality of life, and 5) use of photovoice in SCI/D. Participants discussed challenges with handling the camera, but enjoyed participating and hoped the information would help others with disabilities.

Conclusion: Despite challenges and ethical concerns, these findings suggest, individuals with SCI/D should be included in these studies which empower participants to share what matters most to them with their health and well-being. These findings demonstrate the desirability, feasibility, and utility of using photovoice in individuals with SCI/D, suggesting that use of this and similar participatory methodologies across disabilities is a way to promote health and to minimize health inequalities in research and health care. **Financial Support:** This work was supported by the Department of Veterans Affairs, Office of Research and Development Health Services Research and Development [RRP 13-248].

15. FEASIBILITY AND BEHAVIORAL CHANGES FROM A VIRTUAL HEALTH AND WELLNESS PROGRAM FOR INDIVIDUALS WITH SCI

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Objective: To develop a "virtual gym" providing wellness opportunities specific to exercise using prerecorded exercise videos, peer mentoring/social media interaction, and live group exercise sessions.

Design: Prospective, observational study/cohort

Methods: Ten persons with chronic spinal cord injury (>1 year post injury) who had access to regular internet connection and video webcam usage were enrolled into a 6-week intervention. Pre/post surveys for Exercise Self-efficacy Scale (ESES) and Quality of Life (QLI) were used. Frequency of log-in, social interaction via social media, and attendance for group exercise sessions were also tracked to determine their effect on ESES and QOL. A post intervention qualitative interview was performed to provide feedback and learn of barriers existing with the intervention process.

Results: Paired *t*-tests were performed to determine if the online exercise program had an effect on quality of life and ESES. The mean change in QLI ($M = -0.25$, $SD = 2.78$, $N = 10$) was not significantly different than zero, $t(9) = 0.25$, two-tail $P = 0.809$, providing evidence that this exercise program was not effective in changing QIL scores.

The mean change in the ESES ($M = 2.9$, $SD = 4.04$, $N = 10$) was significantly different than zero at $\alpha = 0.05$, $t(9) = -2.33$, two-tail $P = 0.048$, providing evidence that this exercise program was effective in improving exercise self-efficacy. There was no correlation of frequency of attendance and frequency to the website with exercise self-efficacy scale (ESES) or quality of life (QIL).

Conclusion(s): This feasibility study demonstrates that persons with spinal cord injury can effectively participate in an exercise program virtually. One's confidence level in regular participation in exercise can be strengthened by accessing an online program from home with minimal to no cost and reduced physical barriers. Mentoring and socializing with other persons with spinal cord injury may provide additional benefits outside the realm of exercise alone. This area needs to be researched more thoroughly.

Financial Support: Financial support provided from Mayo Clinic, Center for Innovation internal grant, CoDE 2014.

16. FUNCTIONAL ELECTRICAL STIMULATION ROWING AND BONE DENSITY: FIRST SUBJECT RESULTS

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Objective: Rapid and substantial bone loss which occurs after spinal cord injury (SCI) results in elevated fracture risk. We employ a nine-month functional electrical stimulation (FES) rowing program with the goal of reducing the rate of bone loss after SCI.

Design: Prospective.

Participants/methods: During FES rowing, participants with T1 through T12, motor complete SCI control stimulation of their quadriceps and hamstring muscles using a button on the handle of a rowing ergometer to perform a full-body exercise similar to able-bodied rowing. Participants attend exercise sessions three times per week. Bone mineral density (BMD) measurements are taken at 0, 3, 6, and 9 months using Dual X-ray energy Absorptiometry (DXA) and peripheral quantitative computed tomography (pQCT). DXA scans are taken of the spine, hip and femur (13–20% from the distal end). pQCT scans are taken of the distal femur and distal tibia at 4% from the distal end of each bone. Motion capture and force data are collected during FES rowing at 3, 6 and 9 months. Musculoskeletal models and simulations of movement are used to calculate skeletal forces imposed on the femur and tibia during FES rowing.

Results: We successfully implemented an FES rowing program at VA Palo Alto Health Care System. Our first subject has completed six-month assessments and continues to participate. Allowing for planned absences (e.g. major holidays), adherence to the training program has exceeded 85%. The participant performed 2 weeks of muscle conditioning before learning to row, and then gradually increased FES rowing time per session from 5 to 30 minutes over the following 14 weeks. Between 0 and 3 months, DXA and pQCT indicate bone loss for most sites. At 6 months, DXA indicates increased BMD at the femoral neck, but no effect at the 13–20% distal femur site; pQCT results indicate an increase in BMD in the distal femur and a reduced rate of loss in the distal tibia (4% sites, total and trabecular).

Conclusion: FES rowing may be effective at reducing or reversing bone loss following SCI at the femoral neck and the 4% femur and tibia sites. Dissimilarities in bone response at different skeletal sites may reflect differences in skeletal loading between sites.

Financial Support: Funding was provided by the Department of Veterans Affairs, Rehabilitation Research & Development SPIRE Award B1410P.

17. SEX DIMORPHISM IN ADIPOSITY AND ITS RELATIONSHIP TO GLUCOSE METABOLISM AND PROINFLAMMATORY CYTOKINES IN SPINAL CORD INJURY

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Objective: Adiposity has been vastly reported in spinal cord injury (SCI) literature and linked to metabolic dysfunction. The distribution- and sex-dependent differences of adipose tissue (AT), as well as proinflammatory cytokine secretion are thought to affect insulin resistance. Despite emerging research, sex differences in the relationship between AT and proinflammatory cytokines in SCI are not well understood.

Design: Cross-sectional and correlation; clinical hospital and academic setting.

Methods: Forty-three participants between 18–65 years of age (M/F 36/7, age 42.7 ± 10.5 , BMI 26.5 ± 6.0) with chronic C5–L1 motor complete SCI were included. Participants were classified as A & B according to the international standards for neurological classifications of SCI. All participants underwent an intravenous glucose tolerance test to calculate glucose effectiveness (Sg) and insulin sensitivity (Si) and laboratory assessments, including serum levels of fasting plasminogen activator inhibitor-1 (PAI1), high sensitivity C-reactive protein (CRP), interleukin-6 (IL6), tumor necrosis factor alpha (TNFa), and tumor necrosis factor inhibitor 1 (TAFI1). Noncontrast magnetic resonance imaging to quantify the cross sectional area of visceral (VAT) and subcutaneous (SAT) adipose tissue was performed. Images were separated into VAT and SAT and a VAT/SAT ratio was calculated. Spearman correlations were used to evaluate relationships between sexes.

Results: In both sexes, VAT and VAT/SAT negatively correlated with Si (M: $\rho = -0.50$, $P > 0.001$, $\rho = -0.35$, $P > 0.05$; F: $\rho = -0.86$ and -0.71 , $P > 0.05$, respectively), while VAT negatively correlated only with Sg in males ($\rho = -0.32$, $P > 0.5$). VAT correlated with PAI1 (M $\rho = 0.28$; F $\rho = 0.75$, $P > 0.05$) in both sexes, whereas VAT and TNFa only correlated in males ($\rho = 0.37$, $P > 0.05$). SAT correlated with TNFa ($\rho = 0.36$, $P > 0.05$) in males, while PAI correlated with SAT in females ($\rho = 0.79$, $P > 0.05$). In females, VAT/SAT correlated with CRP and TNFa ($\rho = 0.79$ and $\rho = 0.68$, respectively, $P > 0.05$).

Conclusion: We have elucidated sex-specific correlations suggesting AT may uniquely contribute to glucose metabolism dysfunction in both SCI males and females through proinflammatory cytokines. A better understanding of these relationships can optimize pharmaceutical and rehabilitative interventions following SCI.

Financial Support: VHA RR&D B6757R and NIH UL1RR031990

18. HEALTHCARE UTILIZATION FOLLOWING SCI: REGIONAL REGISTRY DATA

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Background: Individuals with spinal cord injury (SCI) use a disproportionate amount of healthcare and incur greater cost when compared to the general population.

Objective: To identify the incidence and prevalence of healthcare utilization of patients with SCI and to identify clinical patterns of utilization.

Design: Retrospective data analysis utilizing a hospital council data registry including more than 140 hospitals over an area of 15,000 square miles to track healthcare utilization among patients with acute traumatic SCI.

Methods: Six hundred sixty-four patients were admitted with an acute traumatic SCI from January 2003 through June 2014 to a Level I trauma center. Fifty-five patients that expired during initial hospitalization and 18 patients with unspecified SCI were not included in the analysis, providing a total of 591. Outcome measures included demographic, clinical characteristics, cost, healthcare utilization, and diagnosis codes.

Results: At admission, mean age was 46.1 years (± 18.9 years); the majority of patients were male (74%) and Caucasian (58%). Private insurance and uninsured were equal at 40% and 40%. Average total charges were \$37,600 for inpatient encounters and \$1,500 for outpatient encounters. Of the 591 patients, 439(75%) had additional health care utilization accounting for 1849 additional visits with a median of 3 visits per person and a maximum of 22. Of the 1849 encounters, 538(30%) were inpatient visits, 1291(70%) outpatient visits. Approximately 95% of both inpatient and outpatient encounters occurred within one year of the initial injury, and 99% within two years. Furthermore, about half of both the encounters were emergent, and half were elective. The most prevalent ICD-9 codes listed were pressure ulcer, neurogenic bowel, neurogenic bladder, urinary tract infection, fluid electrolyte imbalance, hypertension, anemia, and tobacco use.

Conclusions: Compared to the general population, individuals with SCI experience high levels of healthcare utilization which may be preventable. These hospitalizations are costly to the healthcare system and may also impact unemployment and quality of life. This analysis uniquely and objectively reports healthcare utilization across different systems and is not limited to a single institution. Increasing our understanding of the incidence, prevalence, and cause for healthcare utilization after acute SCI is important to target preventive strategies.

19. HEALTHY HEALERS, NURSE RESILIENCE TRANSFORMING PATIENT CARE

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Description/Background: Nurses who care for spinal cord injured (SCI) patients are at risk for compassion fatigue. The literature associates resilience with the ability of nurses to navigate stressful situations successfully. Having a self-care plan is a crucial factor in preserving resilience and work-life balance. Nurses who are emotionally healthy are also associated with improved patient safety and satisfaction.

Action: A Chief Nursing Officer at a SCI hospital made the commitment to provide practical tools and support regarding raising staff awareness of the importance of self-care and resilience. A fellowship position was developed for a nurse who completed the American Nurses Credentialing Center (ANCC) nursing skills competency program for Caritas Coach, Watson Caring Science Institute. This nurse focuses on coaching the staff about the importance of maintaining emotional and physical health while caring for patients. Using the framework of Watson's Human Caring Science Theory, distinct processes guide nurses to include self when considering caring principles. They integrate skills that enhance resilience and harmony of mind, body, and spirit, including: authentic presence, centering, conscious breathing, mindfulness, intentionality, self-reflection, creative problem-solving, and gratitude. The Nurse Practice Council appointed a committee to examine the hospital's culture, evaluate risks, and seek effective ways to raise awareness of self-care and the link with exemplary patient care. Engaging leadership, creating healing surroundings, and embedding caring-based language in policies, job descriptions, evaluations, and orientation underscores that compassion for self and others is a necessary competency skill in caring for patients and creating a healthy work environment.

Outcomes: Quarterly qualitative surveys scored on a Likert scale for frequency query the staff on a pilot unit about knowledge of self-care concepts, use of self-care practices, and perceptions of relationships with self and others. Results of the baseline survey confirmed the need for increased education concerning factors that contribute to resilience, especially related to self-care practices. Quarterly follow-up surveys will continue to evaluate the progress of staff self-care after focused, individual attention on these topics. A bold vision that values healthy healers and sustains the essential elements of resilience empowers nurses to transform health-care and patient care through the heart of nursing, originating in love.

20. HEALTHCARE UTILIZATION AFTER SPINAL CORD INJURY: POLYPHARMACY, COMORBIDITIES AND THE ROLE OF SPECIALTY CARE AFTER SCI

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Objective: Approximately 17% of people in the US living with a spinal cord injury (SCI) are veterans. Treatment and management of SCI, and related co-morbidities, often continues long after the initial injury. A number of recent analysis suggest that costs associated with SCI are high, due in part to secondary complications and comorbidities that require significant, and ongoing, care. For example Krause and Saunders found that pressure ulcers, amputation, hospitalization and probably major depression significantly reduced overall life expectancy. More fully understanding utilization trends may provide important insights into care practices that can be used by patients, advocates, clinicians, and decision makers to assess strengths and identify opportunities to enhance care for people living with SCI.

Participants: A sample of 18,862 veterans diagnosed with a SCI.

Methods/design: Retrospective database study.

Results: Veterans with SCI who utilized the VA for care tended to be older ($M=58.97$, $SD=13.00$ years), experience polypharmacy ($M=16.93$, $SD=13.72$ number of drugs) and utilize primary ($M=5.04$, $SD=7.23$ visits) and outpatient ($M=25.11$, $SD=23.84$ visits) care frequently. Consistent with these findings, results also suggest a high rate of utilization for specialty care ($M=9.97$, $SD=12.40$ visits). Importantly, nearly one quarter of people living with SCI in this sample were classified as living in a rural setting ($n=4621$; 24.50%). Results also suggested high rates of comorbidity including diabetes, renal disease, chronic pulmonary disease and malignancies.

Conclusion: Results suggest high rates of utilization among veterans with SCI, similar to those observed in the private sector, however, the VA tends to serve older patients who are living with more severe disabilities and a greater number of comorbid conditions. Results also suggest high rates of healthcare utilization in a population in which nearly one quarter of patients live in rural settings, emphasizing the importance of VA's rural health efforts.

21. LEGAL, ETHICAL AND TECHNICAL CONSIDERATIONS ASSOCIATED WITH TELEHEALTH/CONNECTIVE TECHNOLOGIES

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Objective: The problem we deal with today is that too many providers and healthcare organizations deploy telehealth technology for the sake of deploying technology. Very little, if any, consideration is given to individual patient's needs and technological capabilities. The purpose of this presentation is to address this situation by: 1. Reviewing the state of Telehealth technologies in the multiple SCI/D Disciplines and describe how, through the correct assessment of patient needs and capabilities, and, the application of the appropriate telehealth interventions, SCI/D patients and their families can experience an improved quality of life, and, 2. To present the new trends and advancements are affecting the change from conventional Telehealth to Connective Healthcare.

Design: Needs Analysis and Professional Project Planning Protocols.

Participants/methods: Twenty-four VHA SCI/D centers via the VHA SCI/D Telehealth Users Group.

Results: Improved methodologies at the VHA SCI/D centers for the selection and deployment of technologies that are state-of-the-art in patient care.

Conclusion: A pathway for SCI providers to developing patient centric, value add solutions using Telehealth and Connective Healthcare that are not only useful to the improvement of the patient's quality of life but can assist in the efficiency and cost effectiveness of the providers SCI practice.

Financial Support: No outside financial support has been provided.

22. KEYNOTE ADDRESS: LOWER URINARY TRACT DYSFUNCTION AFTER SPINAL CORD INJURY: PATHOPHYSIOLOGY AND DEVELOPMENT OF NEW THERAPIES

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Summary: Functions of the lower urinary tract (LUT) to store and periodically release urine are disrupted by spinal cord injury (SCI) rostral to the lumbosacral level. SCI eliminates voluntary control of voiding, leading initially to bladder areflexia, followed by emergence of automatic micturition and neurogenic detrusor overactivity (NDO) mediated by spinal reflex pathways. However, voiding is commonly inefficient owing to

simultaneous contractions of the bladder and urethral sphincter (detrusor-sphincter-dyssynergia, DSD). Studies in animals indicate that LUT dysfunction after SCI is dependent in part on plasticity of bladder afferent neurons as well as reorganization of circuitry in the spinal cord. Reflex plasticity is associated with changes in the properties of ion channels and electrical excitability of afferent neurons and appears to be mediated in part by increased levels of neurotrophic factors, such as nerve growth factor (NGF). The levels of NGF are increased in the urine of people with NDO; while intramural injection of botulinum toxin A which suppresses NDO reduces NGF levels. Desensitization of bladder afferents by drugs or intrathecal injections of antibodies to neutralize NGF reduces NDO and DSD in animals. Electrical stimulation of nervous tissue (termed neuromodulation or bioelectronic medicine) is another type of therapy that is being evaluated for the treatment of neurogenic LUT dysfunction. Sacral anterior root stimulation in combination with dorsal rhizotomy has been used for many years to induce voiding in people with SCI. More recently, it has been reported that epidural electrical stimulation which is being used in conjunction with exercise training to improve locomotor function after SCI also improves LUT function. Bladder activity is also modulated by electrical stimulation of peripheral afferent nerves. For example low frequency stimulation (6–10 Hz) of afferent axons in pudendal nerves can suppress NDO and promote urine storage, while higher frequency stimulation (30–40 Hz) can induce reflex bladder contractions. When the latter stimulation is combined with ultrahigh frequency (6–20 kHz) stimulation of the pudendal nerve to block axonal conduction in the motor pathways to the urethral sphincter and to suppress DSD, efficient voiding can be induced in SCI animals. The recent identification of neurotransmitter mechanisms involved in neuromodulation also raises the possibility that drugs might be used to target these mechanisms and thereby enhance the efficacy of neuromodulation.

23. MANAGEMENT OF FALL RISK AMONG FULL-TIME WHEELCHAIR USERS LIVING WITH SPINAL CORD INJURY

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Background: Falls are significant problem affecting 30–50% of full time wheelchair users (FTWCU) with Spinal Cord Injury (SCI). After a fall, many individuals experience injuries, activity restrictions and a decline in quality of life and community participation. Despite the consequences, no peer reviewed intervention programs designed specifically for FTWCU with SCI exist on which clinicians can base treatment recommendations. The purpose of this abstract is to describe an intervention program designed to manage fall risk and examine the preliminary feasibility of the program.

Design: Pre/post design. At baseline, transfer quality was evaluated using the Transfer Assessment Instrument (TAI). Study participants were also asked to report the number of falls sustained over the past 6 months. After baseline testing, a structured intervention designed to decrease fall frequency was implemented, as described below. After the intervention, participants were asked to prospectively track fall frequency for 12 weeks. Finally, transfer skills were re-evaluated after 12 weeks.

Methods: A preliminary analysis was performed to examine the impact of a fall prevention intervention on 7 manual FTWCUs with SCI able to perform independent transfers. The content of the intervention was based on the results of a recent literature review in which transfers were found to be frequently associated with falls. Participants were educated on proper transfer techniques using a video and one-on-one instruction. Wilcoxon Signed Rank Tests were used to compared TAI scores and fall frequency pre and post exposure to the intervention.

Results: Participants were an average age of 34 years and living with a SCI for 31 years. Level of injury ranged from T6–L3. The intervention program was well tolerated and no injuries were reported. Participants reported the intervention easy to follow and it fit easily into their schedule. No significant differences were found among TAI score (Pre: 7.68 ± 0.55 , Post: 7.86 ± 1.06 , $P=0.866$) or fall frequency (Pre: 1.3 falls/month, Post: 1.4 falls/month, $P=0.753$).

Conclusions: This study is the first to describe a structured intervention designed to decrease fall frequency specifically among FTWCU with SCI. The intervention received positive reports from participants and is the

first of its type to target a significant problem. Further testing is necessary to fully examine the quantitative impact of the intervention.

Financial Support: Craig H. Neilsen Foundation (Pilot Psychosocial Research Grant Program #323277)

24. MANAGEMENT OF INFERTILITY IN MEN WITH SPINAL CORD INJURY

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Summary: Spinal cord injury (SCI) occurs most often to young men at the peak of their reproductive health. Following SCI, the majority of men are infertile. Approximately 90% are anejaculatory. Currently, there is no universal standard of care for the management of infertility in men with SCI. This is largely due to a lack of education of healthcare providers at all levels. Consequently, couples with male partners with SCI who wish to achieve biologic parenthood are often over-treated with expensive and unnecessary procedures. Practitioners need to be educated in all aspects of managing infertility in these couples, including the following:

1. Causes of infertility in men with SCI
 - a. Erectile dysfunction
 - b. Ejaculatory dysfunction
 - c. Abnormal semen quality
2. Methods of semen retrieval in men with SCI
 - a. Managing autonomic dysreflexia during semen retrieval procedures
 - b. Video demonstration of penile vibratory stimulation (PVS)
 - c. Video demonstration of electroejaculation (EEJ)
 - d. When should these methods be used?
 - e. Algorithm of treatment for anejaculation in men with SCI
3. Semen quality in men with SCI: facts and fiction
 - a. Which sperm parameters are normal, which are abnormal?
 - b. What causes abnormal semen quality in men with SCI?
 - c. Can anything be done to improve semen quality in men with SCI?
4. Management of the couple with an SCI male partner
 - a. Who is a candidate for intravaginal insemination (at-home insemination)?
 - b. Who is a candidate for intrauterine insemination?
 - c. Who is a candidate for in vitro fertilization (IVF)?

The program has been developed as part of the Craig H. Neilsen Foundation's Quality of Life Sustainable Impact Projects. As such, support is available to provide more in-depth training sessions to centers or individual practitioners.

Financial Support: Craig H. Neilsen Foundation

25. ORDER OF PERFORMING THE SENSORY TESTING AS PART OF THE ISNCSCI EXAMINATION

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Objective: The neurological examination recommended as part of the International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI) includes the testing of two modalities of sensation, light touch (LT) and pin prick (PP). The order in which these two sensory tests are performed varies by clinician. Some advocate

the use of the cotton swab for light touch first, thinking that it is less painful. This study was performed to determine patients preference in the test performed.

Design: A questionnaire was administered following the standard exam to determine patient preferences. Specific questions included the level of discomfort experienced from each sensory modality, whether they preferred one versus the other to be performed first and whether they would have preferred being given the choice of modality tested. Demographic information, including age, duration of injury, sex, and number of previous examinations, level and severity of injury, as well as the order of the testing performed was obtained.

Participants/Methods: Subjects were recruited who were undergoing the ISNCSCI examination and included new inpatients as well as outpatients at a SCI center. Nineteen patients completed the approved questionnaire.

Results: Of the sample, 89.5% were male, 53% had a neurological complete injury, 42% with tetraplegia and 16% reported this being their first examination. Of these examinations, 32% had PP performed first. All patients found the LT to be “not painful”. For PP, 5.3% reported that this was “very painful”, 15.8% “moderately painful” and 79% “not painful”. From the patient preferences, 78% had no preference with 11% preferring LT and the same percentage PP to be performed first. None of the patients wanted to be asked which one of the modalities should be tested first (i.e. to be given a choice). No correlation was found between patient preference and sex, age, level or severity of the injury, or the number of previous neurological examinations.

Conclusion: There does not seem to be a patient preference in the order of the sensory modality tested in patients with spinal cord injury.

Financial Support: NIDILRR grant #90SI5011

26. PARTICIPATION AMONG SPINAL CORD INJURED INDIVIDUALS WITH AND WITHOUT PTSD

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Objective: Individuals with spinal cord injuries/disorders (SCI/D) often have PTSD; in Veterans with SCI/D this may be compounded by threat of trauma incurred through military experiences. Function, including social participation, may be hindered by PTSD symptoms in persons with SCI/D. Study objectives were to examine differences in social participation among Veterans with SCI/D with and without PTSD, and determine if lower perceptions of participation were independently associated with having PTSD.

Design: Cross-sectional mailed national survey.

Participants/methods: Surveys were mailed to Veterans with SCI/D who received prior-year VA healthcare in late 2014–early 2015, with a 4-week follow-up to facilitate response. Surveys provided demographics, select health conditions, injury characteristics, and patient perceptions of social participation using a scale validated in the SCI population. Analyses included bivariate comparisons (comparing all variables between Veterans with SCI/D who did vs. did not have PTSD), and a multivariate logistic regression to determine if lower perceptions of social participation were independently associated with PTSD when controlling for covariates.

Results: Approximately 17% of the sample (n=896) had PTSD. Veterans with PTSD reported lower social participation (40.2 vs. 43.9, $P<0.0001$) than those without PTSD. Multivariate analyses indicated that longer duration of injury (OR=0.98, CI95: 0.97–1.00, $P=0.03$) and being white (OR=0.60, CI95: 0.37–0.98, $P=0.04$) were associated with lower odds of having PTSD, while having a greater number of co-occurring health conditions (OR=1.42, CI95: 1.25–1.62, $P<0.0001$) was associated with greater odds. When controlling for covariates, lower reported levels of social participation were independently associated with having PTSD (OR=0.94, CI95: 0.90–0.98, $P=0.01$).

Conclusion: Having PTSD negatively impacts social participation among persons with SCI/D, independent from injury-related factors and other variables which may impact participation in social activities. Social participation is an important facet of community integration following SCI/D. As such, efforts to screen for and treat PTSD

among persons with SCI/D, regardless of injury-specific factors, are needed to improve participation in this vulnerable patient population.

Financial Support: This work was supported by the Department of Veterans Affairs, Office of Research and Development Health Services Research and Development [RRP 13-248].

27. PERCEPTIONS OF AGING AND HEALTHCARE AFTER SPINAL CORD INJURY

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Objective: To gather consumer, primary care provider (PCP), and rehabilitation provider perspectives on health-care and aging with spinal cord injury (SCI).

Design: Qualitative analysis of focus group and individual interviews.

Participants/methods: PCPs, rehabilitation providers, and consumers with SCI participated in focus groups or individual structured interviews, or responded to an online questionnaire about healthcare and aging with SCI. Participants were recruited from Washington, Alaska, Montana and Idaho. Each interview transcript or response sheet was reviewed by two individuals, to compile themes and quotes from each participant group.

Results: Similar themes emerged from analysis across participant groups, but with divergent perspectives on some themes. Most consumers reported having a PCP, but had varying levels of confidence in their PCP's ability to manage their SCI health. Both consumers and PCPs noted that most PCP visits are focused on addressing secondary medical complications from SCI, with less emphasis on general health maintenance. Consumers with SCI cite concerns about insufficient knowledge about aging complications, and feel this topic is inadequately addressed by their health care providers, including rehab providers. PCPs were uncertain about specific health risks posed by aging with an SCI, and did not routinely screen for these risks. While rehab providers reported that consumers received most of the important SCI education as inpatients, consumers both perceive and prefer that the bulk of education occurs in the outpatient environment. Consumers, PCPs and rehab providers agree that education regarding common secondary medical complications from SCI would facilitate primary care and general health maintenance for this population, but are uncertain as to where to access this information.

Conclusion: Consumers, primary care and rehabilitation providers identify the need for education, resources and clinical care focused on preventing health complications and fostering successful aging after SCI. Consumer preference for outpatient-based education should be considered in the development and integration of educational programs and products.

Financial Support: This study was conducted for The Empowerment Project, a Sustainable Impact Project supported by the Craig H. Neilsen Foundation.

28. PEER-SUPPORTED PATIENT EDUCATION APPROACHES IMPROVE OUTCOMES; INTERRUPTED TIME SERIES DESIGN

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Objective: To test the effectiveness of using chronic disease self-management approaches for patient education that put peers at the center of education content and delivery in spinal cord injury (SCI) rehabilitation.

Design: Interrupted time series

Participants/methods: All persons receiving inpatient rehabilitation for SCI attend patient education classes and thus, are included as participants. We adapted the Stanford Chronic Disease Self-Management (CDSM) model

to fit inpatient SCI rehabilitation, enhanced interactive content of patient education classes, and put peers at the center of education and training processes. Traditional didactic lecture type patient education classes presenting 'textbook' type information were rewritten to identify what patients need to know 'right here/right now' and focus on problem solving abilities delivered in roundtable discussions led by people with SCI who have 'been there, done that.' Challenges and successes of replicating this approach in a different setting will be discussed.

Results: Preliminary Interrupted Time Series analyses of rehospitalization rates show a significant decrease in slope for readmission after intervention. Patient engagement in the revised content/delivery classes is significantly greater ($P < 0.001$) compared to traditional style classes. Qualitative data obtained from interviews show that patients report gaining more information from revised classes and believe they are more active participants in these classes.

Conclusions: Peer-supported self-directed education approaches following the CDSM model result in significant improvements in patient engagement during SCI rehabilitation patient education classes and fewer rehospitalizations. These findings support the concept that patients learn better "from people like me" and that rehabilitation systems of care that supplement traditional approaches of care delivery with peer-supported patient-centered care initiatives will improve outcomes, including rehospitalization rates.

Additional research will examine relationships of patient-centered approaches during rehabilitation with longer-term patient reported outcomes after discharge.

Financial Support: Patient-Centered Outcomes Research Institute

29. PEER-SUPPORTED SELF-DIRECTED CARE OPTIMIZES SUCCESSFUL COMMUNITY TRANSITION AFTER CATASTROPHIC INJURY

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Objective: Patient-centered care has become the cornerstone of healthcare improvement initiatives, peer directed education, counseling, and training has been shown to assist with retention and engagement. Our goal was use scientific methods to prove the value of this approach in spinal cord injury (SCI) rehabilitation where patients must learn to self-manage injury conditions that will become permanent parts of their new life after injury.

Design: Randomized control trial.

Participants/Methods: One hundred fifty-eight patients with SCI receiving inpatient rehabilitation were randomized to an experimental group who received intensive peer mentoring during and following SCI rehabilitation or a control group that did not receive the intervention. The intensive intervention included one hour of private session peer mentorship each week during rehabilitation, inclusion in peer supported activities, and weekly follow-up (typically telephone conversation) for 90 days post discharge. Peer-mentoring was provided by persons with SCI—either staff members in the peer mentor department or volunteer mentors who matched demographic characteristics of the patient. Support was also provided to the patients' families, if requested. Patient reported outcomes were obtained via telephone interview at multiple time points after discharge.

Results: Persons randomized to the experimental group that received intensive peer support during and after rehabilitation had significantly fewer re-hospitalizations in the 90 days after injury ($P = 0.011$) compared to the control group. Longitudinal growth curve analyses show that persons randomized to the experimental group had significantly higher growth rates of self-efficacy scores than persons randomized to the control group ($P < 0.0001$). Initial self-efficacy assessments were significantly determined by age and sex, however, they did not significantly affect the rate of growth. Group randomization is the only covariate that significantly affected rate of growth.

Conclusion: The peer-supported self-directed care approach that includes peer mentorship during and following inpatient rehabilitation for SCI is significantly associated with better outcomes. Organizational support is essential for these programs that enhance the patient experience and result in fewer rehospitalization, increased self-efficacy, and increased patient satisfaction.

Financial Support: Patient-Centered Outcomes Research Institute

30. PERFORMANCE OF THE SPINAL CORD INDEPENDENCE MEASURE-III IN YOUTH WITH SPINAL CORD INJURY

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Objective: To report mean (M), standard deviation (SD) and range (R) of SCIM-III scores in youth with spinal cord injury (SCI), and to examine content range, test-retest reliability, and concurrent validity.

Design/Method: Repeated measures using a convenience sample of youth with chronic SCI. SCIM-III was administered twice by way of interview. Summary\descriptive statistics were used to characterize the sample and to calculate M, SD and R of SCIM-III scores. Intraclass Correlation Coefficients (ICC) and 95% confidence intervals (CI) were used to evaluate test-retest reliability, coefficient of skew and percentages for ceiling\floor effects were calculated and, Spearman Correlation Coefficient was calculated to examine concurrent validity, using the FIM as the Gold Standard. Data were analyzed for the total sample, age groups = 12 and = 13, and motor complete (AIS A\B) and incomplete (AIS C\D) injuries.

Results: Eighty-nine youth with M age of 10.1 years (R 2–17) participated. The majority was non-Hispanic (85.4%), had paraplegia (69.7%) and complete injuries (AIS A) (38.2%). The M total SCIM-III score for the entire sample (n=89) was 62.21 (SD 20.87, R 92), for age groups = 12 (n=58) M=61.64 (SD 19.39, R 84), and = 13 (n=31) M=63.60 (SD 23.26, R 92), for motor complete injuries (AIS A\B) (n=43) M=61.64 (SD 19.39, R 84) and incomplete injuries (AIS C\D) (n=25) M=78.24 (SD 15.07, R 53). Reliability was high for all comparisons (ICC ranged from 0.96–0.98, 95%, CI ranged from 0.95–0.99). There were no floor effects, and ceiling effects were negligible (1.12% for entire sample, 2.32% for =13 years, 4.0% AIS C\D). Coefficient of skew was –0.37 for entire sample, –0.71 for =13 years, and –0.27 for AIS C\D. Concurrent validity was strong (0.92, P<0.001).

Conclusion: When administered to children with chronic SCI via interview, the SCIM-III has strong reliability and validity, no floor effects and negligible ceiling effects.

Financial Support: This study was funded by the Craig H Neilsen Foundation, Protocol # 282592 (Mulcahey, PI).

31. PILOT INTERVENTION FOR CAREGIVERS OF YOUTH WITH SPINAL CORD INJURY

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Objective: To date, no interventions targeting key outcomes among caregivers of youth with SCI have been conducted. The current study explored the effectiveness of a pilot intervention to support primary caregivers of youth with spinal cord injury (SCI).

Design: The intervention included a 2-day, in-person group session providing education and caregiver networking. Caregiver participants were then randomly assigned to 12 monthly phone calls from a mental health professional (MHP, “intervention”) or services as usual (“control”).

Participants/methods: Caregivers of 7–18-year-old youth with SCI of at least 1-year duration were recruited from a pediatric hospital system and community-based providers. Caregivers completed measures of problem-

solving, anxiety/depression, leisure-time satisfaction, quality of life (QOL), physical health, and burden before the in-person session and 12 months later. Cohen's *d* was used to assess the magnitude of the intervention's effect size (ES) for each construct (.2=small/.5=medium/.8=large).

Results: The 41 caregivers were primarily mothers (85%), Caucasian (85%), married (61%), and had at least some college (85%). Children had a mean age of 11.49 years (SD=3.17) at intervention start and 4.32 years (SD=4.11) at injury, 63% were male, and 73% had paraplegia. The intervention group (n=21) seemed to experience improvements in positive problem-solving (ES=0.524), leisure-time satisfaction (0.235), and anxiety (0.228). Further, those who talked with the MHP for at least 129 minutes ("high-dose" intervention, n=11) experienced even greater gains in these areas, and improvement in depression (0.454), QOL (0.336) and overall problem-solving (0.215). The "high-dose" group had worse baseline status than the "low-dose" group, suggesting they were more in need of (and took advantage of) contact with the MHP.

Conclusion: This intervention showed promise in improving key caregiver outcomes, especially for caregivers who were struggling. Future research should determine how to target negative problem-solving behaviors, burden, and physical health among caregivers.

Financial Support: Craig H. Neilsen Foundation (#288993)

32. PRACTICE MAKES PERFECT: QUALITATIVE RESEARCH IN SPINAL CORD INJURY HEALTHCARE

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Summary: Currently, there is a focus on building capacity for patient-centric qualitative research towards improving care, services and quality of life for individuals with spinal cord injury and disorders (SCI/D). It is important to consider research methods that address the *practice* of qualitative research as it actually occurs on the ground. Using examples from a project designed to identify strategies for activity and wellness in persons with SCI/D, we a) illustrate how to adapt classical social science methods for multidisciplinary research teams, b) discuss the development of stakeholder participation as a core part of the research and c) provide insights into analytical approaches demonstrating how qualitative enquiry complements quantitative data collection. Blending classical methods from the social sciences with applied anthropology and stakeholder participation in healthcare research can be an effective approach. This includes training researchers in qualitative methods, co-designing research with stakeholders, and familiarizing practitioners about expected outcomes. Clinical research standards rest on factors such as validity, generalizability and reproducibility. For social scientists, data discovery is adaptive and iterative. Adaptability enables open-ended interviewing to jointly uncover meaningful stories and examples with participants, often in their home or other familiar setting. Ethnographic techniques use triage as you revisit data to deepen insights. While literature exists on qualitative research and participatory design in the health sciences, guidance on how to recalibrate classical methodologies for interdisciplinary teams is rarer. Examples include matching methods with needs and capabilities of coworkers from diverse disciplines, involving stakeholders in creating research questions, training colleagues, and building trust with interviewees, and how to introduce tools on the fly in response to contingencies while keeping data quality and veracity intact. With interdisciplinary teams, new methods and epistemologies take time to acquire. Establishing interdisciplinarity takes practice. The artful construction of a research team can generate extraordinary results. As qualitative methods are embraced and employed more widely by researchers from different disciplines, adaptiveness, expediency and stakeholder participation may be among the most salient factors for conducting robust and relevant qualitative research in the future.

33. PRESSURE MAPPING AND ACCELEROMETRY METHODOLOGY TO MONITOR INDIVIDUALS WITH SPINAL CORD INJURY

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Background: Interface Pressure mapping (IPM) for wheelchair seating allows clinicians insights of how seating configurations effect pressure distribution. PVA guidelines recommend that pressure reliefs should be held at least 1–2 minutes every 30 minutes. Other studies have examined ideal recline/tilt combinations for optimal pressure relief. A therapeutic range of 60-to-120 mmHg is commonly used clinically to compare seating forces. Our purpose was to better understand how wheelchair positions and changes in trunk positioning affect seating pressure over time.

Design: Three inpatients with spinal cord injury (C-4, ASIA A, C-4, ASIA C, C-2, ASIA D) were enrolled. Each participant was seated on an IPM system, instrumented with a three-axis accelerometer on the trunk and monitored for three hours with instructions to carry out normal activities. Angles calculated from the accelerometer provided true trunk position. Pressure map data were analyzed for left and right sides that included the ischial contact area. Data were processed for average and peak pressures on both sides, the technique of collapsing adjacent sensels to estimate peak pressure was explored.

Results: Mean time in the wheelchair was 2.9 hours. Mean time in the respective trunk reclined positions differed among the three participants: 0–20° (22, 32.3, and 80 min), at 20–40° (4.5, 10.6, 47 min), at 40–60° (3.0, 0, 7.7 min) and at >60° (2 seconds, 0, 0 min). Mean average and peak forces (mmHg) for all three participants respectively were 32.2 (range 27.1–40.1) and 84.3 (range 53.1–141.6). Peak pressure with collapsing adjacent sensels was 20% less than peak pressure from the whole array. No significant changes in average or peak pressure were noted for any of the reclined angles except for Subject 3 who had a 59% right- and 71% left-sided lower average pressure and 50% lower right-sided peak pressure at 40–60 decline. Average pressures were symmetrical, but peak pressures differed between right and left in two individuals by 32% and 49%, respectively. No significant changes in average or peak pressures occurred over time except in one subject (47% reduction in peak pressure).

Conclusions: Continuous pressure mapping provides evidence of when meaningful changes in seating pressure occur. Changes in peak and average pressures as well as (a) symmetry of seating can be determined. Averaging of adjacent sensels controls for overestimating peak pressures. Time course monitoring with IPM and accelerometry is useful to assess compliance, duration, and extent, of pressure relief in wheelchair users.

34. PREVALENCE OF MENTAL DISORDERS AMONG U.S. MILITARY VETERANS WITH SCI

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Objective: Individuals with spinal cord injury (SCI) are at higher risk of depression, substance abuse, and other mental health concerns. Despite the added burden of mental disorders on the patient, family members, and society, little is known of mental disorder prevalence and comorbidity among the 42,000 military veterans with SCI. The objective of this study was to estimate the point prevalence of mental disorders in this population and identify patient characteristics that are risk factors.

Design/Methods: A retrospective medical records review was conducted for 280 patients attending annual evaluations at a VA SCI & Disorders Center. The review included VA administrative data and clinical notes written by SCI psychologists and other providers. Mental disorder diagnoses were extracted from psychologist notes.

Results: Patients were primarily male (96%), half were Caucasian (50%), and had a mean age of 58 years. The majority of SCIs had traumatic etiology (70%), were of a cervical level (59%), and were incomplete (70%). In all, 39.9% received at least one mental disorder diagnosis with 63–71% having at least one comorbid diagnosis

from another diagnostic category. The most common diagnoses were depressive disorders (19%), Posttraumatic Stress Disorder (PTSD, 12%), and substance/alcohol use disorders (11%). Standard binary logistic regression analyses were conducted to identify risk factors for mental disorders. Minority status, non-traumatic SCI etiology, and SCI completeness (AIS D>AIS A) significantly increased the risk of depressive disorders and PTSD. Being aged 71 years or older significantly lowered the risk of depressive disorders whereas those of the Vietnam era (61–70 years old) had the highest risk of PTSD. Regarding substance/alcohol use disorders, only minority status significantly increased risk. Years since SCI, age at SCI, and level of SCI injury did not impact risk of mental disorder diagnosis.

Conclusions: Nearly 40% of veterans with SCI received a mental disorder diagnosis, putting them at higher risk of health complications, lower quality of life, and higher caregiver stress. Early detection through efficient screening programs and readily available mental health resources for assessment and treatment are essential for optimizing psychosocial outcomes after SCI. Future research is needed to inform best practices in the detection and treatment of mental disorders in SCI.

Financial Support: Department of Veterans Affairs (1K2RX000703-01).

35. PROBLEM-SOLVING IN ADOLESCENTS WITH SPINAL CORD INJURY AND THEIR CAREGIVERS

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Background: Social problem solving (SPS) skills have been linked to successful transitions for young adults with and without disabilities. Relatively little is known about SPS among youth with spinal cord injury (SCI); however, past research has shown that the presence of negative coping negatively impacts quality of life (QOL). The objective of this study was to explore negative SPS orientation and its relation to family factors and youth outcomes.

Design: Patients within a pediatric specialty hospital system and their caregivers completed a standardized measure of their own social problem solving, and youth completed measures of their depression and QOL. Demographics were gathered through a chart review and caregiver questionnaire.

Methods: Youth ages 13–18 with SCI for at least one year were recruited during inpatient or outpatient visits and completed data on paper or through an online platform. Pearson correlation coefficients assessed relationships between demographics, youth depression, and negative SPS orientation (parent and child). A hierarchical multiple regression analysis was conducted with parent variables in the first block, youth variables in the second block, and youth psychosocial QOL as the dependent variable.

Results: Within the 50 youth-caregiver dyads, youth were an average of 15.6 years (SD=1.47) at interview and 7.7 years (SD=5.84) at injury. Fifty-four percent were male, 72% Caucasian, and 62% had paraplegia. Caregivers were 45 years (SD=6.95) at interview. Negative SPS orientation was endorsed at low rates for both youth and parents. Over half of youth and parents (58% and 60%, respectively) reported negative SPS orientation as “not at all true” to “only slightly true”. Taken together, youth variables significantly contributed and accounted for 54% of the variation in youth psychosocial QOL ($P<0.001$). After controlling for all other variables, increased youth negative SPS orientation, youth depression, and parent negative SPS each uniquely contributed to decreased youth psychosocial QOL.

Conclusion: Family interventions to reduce negative SPS orientations may bolster psychosocial QOL of youth living with SCI. Additional research is needed to explore other factors impacting youth problem solving including peer influences, social and academic success, and parent mental health.

Financial Support: Shriners Hospitals for Children, #9143

36. PSYCHOSOCIAL FACTORS ASSOCIATED WITH PAIN INTERFERENCE IN PERSONS WITH SCI/D

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Objective: Pain following a spinal cord injury/disorder (SCI/D) can significantly impact psychosocial health and quality of life. Study objectives were to compare factors related to psychosocial well-being in Veterans with SCI/D and high vs. low pain interference, and determine if lower psychosocial well-being is associated with pain interference when controlling for covariates.

Design: Cross-sectional mailed survey.

Participants/methods: Surveys were mailed in late 2014–early 2015 to a national sample of veterans with SCI/D who received prior-year VA healthcare, a follow-up mailing was conducted 4–6 weeks later to facilitate response. Surveys assessed demographics, injury-related factors, select health conditions, pain interference (as measured by the SCI-QOL Pain Interference short form) and psychosocial well-being (positive affect, grief/loss, negative psychosocial illness impact, resilience, life satisfaction). Bivariate comparisons compared all variables between Veterans with SCI/D who reported above mean ('high') vs. below mean ('low') pain interference. Multivariate linear regressions identified how psychosocial factors related to pain interference, controlling for covariates.

Results: About 79% of the sample (n=813) reported high pain interference. Veterans with high pain interference reported worse perceptions of psychosocial well-being compared to those with low pain interference. Multivariate linear regressions indicated that living with a family member, friend or spouse and having a greater number of health conditions was related to high pain interference. When controlling for confounders (demographic and injury-related factors), high pain interference was associated with higher grief/loss and negative psychosocial illness impact, and lower positive affect, resilience, and life satisfaction.

Conclusion: Experiencing pain is associated with poor psychosocial well-being among veterans living with SCI/D, independent of other factors that may influence psychosocial wellness. Efforts targeted toward improving one or more factors associated with psychosocial adjustment to injury may be warranted and highly beneficial for persons with SCI/D who experience pain. Such efforts may be facilitated by effective pain management programs that are aligned with patient preferences for treatment.

Financial Support: This work was supported by the Department of Veterans Affairs, Office of Research and Development Health Services Research and Development [RRP 13-248].

37. JAYANTHI LECTURE: SACRAL EXAMINATION IN CHRONIC SPINAL CORD INJURY: IS IT REALLY NEEDED?

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Background: The components of the sacral examination as described by the International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI) are used to determine whether the injury is classified as neurologically complete or incomplete (presence or absence of 'sacral sparing'). However, the rectal exam components are also invasive and unpleasant with possible associated complications. This raises the question of whether patient self-report is accurate in determining S4–S5 motor and sensory function. The purpose of this

study was to determine if a self-report measure of S4–S5 motor and sensory function in patients with chronic SCI accurately predicts sacral examination classification in a clinical setting.

Design: Prospective, observational self-report survey compared with sacral examination performed according to the ISNCSCI.

Methods: One hundred sixteen English-speaking patients aged 18 or older with chronic SCI (>6 months) whom had previously undergone sacral examination participated during a follow-up visit. A survey was first completed with participants which included demographic/clinical information, and sacral function information including light touch (LT), pinprick sensation (PPS), deep anal pressure (DAP) and voluntary anal contraction (VAC) using neutral side-specific questions (e.g. “Yes, I do have pin prick sensation on the left side of my rectum/anus”). Results of the survey were blinded from the physician who performed the standard of care sacral exam. Results from the survey and sacral examination were compared and stratified by the patient’s ASIA Impairment Scale (AIS).

Results: The mean age of patients was 41.3 ± 14.4 years, with a majority of patients being male (69%) and Caucasian (71.6%). Overall, Positive Predictive Value (PPV) ranged between 48% (VAC) to 73% (DAP) and Negative Predictive Value (NPV) between 92% (VAC) to 98% (LT). Based on AIS, individuals with AIS-A (n=63) had lower PPV (DAP 10%, VAC 9%, PPS 0%, LT left 9%, right 17%) and higher NPV (DAP 100%, VAC 100%, PPS 100%, LT 100%) than AIS-B/C/D. Conversely, people with AIS-D (n=22) had higher PPV (DAP 100%, VAC 100%, PPS left 100%, right 93%, LT left 93%, right 100%) and lower NPV (VAC 25%, PPS left 20%, right 45%, LT left 0%, right 50%).

Conclusion: Overall, it appears that the S4–S5 motor and sensory function portion of the AIS examination remains necessary, particularly for AIS-B/C. AIS-A patients tend to predict negative sensation more accurately, and AIS-D patients tend to predict positive sensation more accurately.

38. SAFETY OF AQUATIC THERAPY FOR ADULTS WITH COMPLEX MEDICAL CONDITIONS AMONG CHRONIC SPINAL CORD INJURY

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Objective: Demonstrate safety within aquatic environment for patients with spinal cord injury (SCI) with pressure ulcers, colostomy or ileostomy bags, supra pubic catheters, indwelling catheters, and tracheostomy tube, Describe aquatic interventions and task modifications for pressure ulcers, colostomy or ileostomy bags, supra pubic catheters, indwelling catheters, and tracheostomy tubes in adult patients with chronic spinal cord injury, and assess the impact of aquatic therapy on family and caregiver-reported quality of life.

Design: Retrospective chart review

Participants/methods: Data collected were obtained from medical charts after the patient was discharged from aquatic-based therapies. Relevant demographic, clinical and outcomes information were retrieved for entry in to this research. Inclusion criteria include patients 18 years old and older, and have a chronic (> 1 year) spinal cord injury (any neurological level, any AIS classification) who received treatment at Aquatics Department of Kennedy Krieger Institute.

Results: Aquatic based restorative therapy in 100 patients with spinal cord injury was an effective therapy to produce significant improvements in a variety of endpoints including upper & lower extremity strength, Modified Ashworth Scale, 6-minute walking distance, and functional reach test. Patients with Stage 2 and 3 pressure ulcers required protection using OpSite. No maceration or worsening of the wound were noted. Those with colostomy bags required ostomy bag to be picture frame taped to clean, dry skin with waterproof dressing before pool session. Only one reported accident was noted which required the pool to be shocked with appropriate chemicals. No untoward medical complications were noted with the patient. Supra-pubic and indwelling catheters required them being secured to their body or floats. No incidence of catheter being pulled out was noted. Patients with tracheostomies required that they tolerate capping for a minimum of 4

hours. The water level was maintained at the nipple level. No desaturation or respiratory complications were noted among these patients.

Conclusion: This study demonstrates the safety and feasibility of aquatic therapy for adult patients with spinal cord injuries and pressure ulcers, colostomy or ileostomy bags, supra pubic catheters, indwelling catheters, and tracheostomy tube. Aquatic therapy is a valuable therapeutic tool for patients with SCI with various complex comorbidities.

39. SCOPING REVIEW OF SUPPORTED EMPLOYMENT RESOURCES FOR SPINAL CORD INJURY

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Background: Recent research has shown that the individual placement and support (IPS) supported employment (SE) is effective in improving employment outcomes and quality of life for persons with spinal cord injury (SCI). The use of SE in SCI rehabilitation, however, involves substantive changes in usual practice. Therefore, the field of SCI rehabilitation needs resources to facilitate the adoption of IPS SE interventions. **Objective:** The goal of this project was to identify and gather together available resources such as tools and educational materials to facilitate use of IPS SE in SCI rehabilitation.

Methods: A scoping review of databases (Cochrane Review Database, Dissertation Database, OvidMD, PsycINFO, PubMed, and Web of Science) was conducted of articles published between 2002 and 2015. Search terms used were: "supported employment", "tool", "toolkit", "training", "individual placement and support", "facilitators", and "vocational rehabilitation". Inclusion criteria: An SE resource was (1) described or referenced, or (2) used for SE or IPS. Exclusion criteria: (1) No English translation, or (2) full-text article or tool not available. A grey literature search was also conducted of internet resources and unpublished materials.

Results: Of 1513 articles screened, 50 were assessed for eligibility and 2 met inclusion criteria. From the grey literature, 23 resources were identified such as web-based trainings, DVDs, and manuals. The tools were grouped into 4 categories: General IPS SE (n=18), benefits counseling (n=3), SCI orientation (n=2), and SE in SCI (n=2).

Conclusion: Evidence-based resources for SE in SCI are sparse, indicating a need for them in the field. In summer 2016, an advisory panel will review the 25 resources and offer recommendations on content and format to facilitate the development of a SE in SCI toolkit. The advisory panel consists of experts in SE or SCI who are from Veterans Affairs and the private sector and includes members who are Veterans and/or persons with SCI. The panel will also advise on plans to disseminate the toolkit broadly to the SCI rehabilitation community. The ultimate objective of this project is to provide rehabilitation professionals with a toolkit for using evidenced-based services that improve employment outcomes.

Financial Support: Craig H. Nielsen Foundation Quality of Life Grant *Tools for a working life with SCI: Translating evidence-based employment services into practice.*

40. SEAT DUMP ANGLE AFFECTS SPINE AND SCAPULAR MOTION DURING PROPULSION

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Objective: To quantify and compare spinal curvature and scapulothoracic and glenohumeral kinematics throughout the MWC propulsion cycle while individuals with spinal cord injury (SCI) were sitting in two different seat dump angle conditions, 0 and 14 degrees.

Design: Cross-sectional, repeated-measures design

Participants/methods: Participants with SCI (n=21, 16 male, mean age: 41.9 years, SCI injury level: C6/C7 to L2) who use a MWC were recruited and evaluated in the two experimental seating conditions. Spinal curvature, from C7 to S1, was measured with a fiber-optic system and quantified as regions of sagittal plane lordosis and kyphosis, in degrees. Shoulder kinematics of each individual's dominant arm were measured with an electromagnetic system. Spinal curvature and shoulder kinematics were compared at specific events during the propulsion cycle (start of push (SP), mid push (MP), end of push (EP), and mid recovery (MR)) between conditions using a paired *t*-test or Wilcoxon signed-rank test ($\alpha=0.05$). Comparisons were made with the full group of participants and injury level subgroups: high (T9 and above, n=11) and low (T10 and below, n=10).

Results: In the 14 degree condition, lordosis was significantly lower at all propulsion events relative to the 0 degree condition (median differences: 2.00 to 4.58°), particularly in those who had low SCI (4.25 to 9.02°). No differences were detected in kyphosis. In the 14 degree condition participants propelled with more scapulothoracic internal rotation (mean difference: 2.51° (SP) and 2.74° (MP)) and less relative upward rotation (mean difference: 2.37° (SP) and 2.14° (MP)), the difference was even greater in those with high SCI (mean difference, internal rotation: 4.61° (SP), 4.06° (MP), and 3.87° (MR) and upward rotation: 4.45° (SP), 4.06° (MP), 3.87° (MR)). No differences were detected in glenohumeral kinematics at any event across the propulsion cycle.

Conclusion: Both scapular kinematics and spinal curvature during propulsion differed between 0 degree and 14 degree seat dump angle conditions, however, the differences may be dependent on SCI level. Additional work is needed to elucidate the benefit or disadvantage of these changes and understand the relationship between the spine and shoulder kinematics.

Financial Support: Personnel were supported by PODS II Scholarship, Foundation for Physical Therapy (BAC), NIH/NCATS TL1 TR000137 (BAC), NIH/NIAMS T32AR56950 (AME).

41. SELF-CARE BEHAVIORS IN PERSONS WITH SCI/D: RESILIENCE AND OTHER FACTORS

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Objective: Individuals with a spinal cord injury/disorder (SCI/D) must learn to adjust to and manage functional challenges after SCI/D onset. For these individuals, resilience (e.g. the adaptive response to stressful events) may be related to their willingness and ability to conduct self-care behaviors. The study objectives were to examine the relationship between patient-reported perceptions of independence in performing self-care behaviors and resilience among Veterans with SCI/D, and to examine variables (including resilience) associated with high self-care scores (controlling for confounders).

Design: Cross-sectional national survey including questions on demographic, injury, and health characteristics, as well as validated scales assessing patient-reported 'resilience' and 'self-care.'

Participants/methods: The survey was conducted with a random sample of community-dwelling adults with SCI/D who, in the prior year (2014), had received care at a Veterans Affairs SCI/D System of Care facility. We conducted bivariate analyses to examine differences in demographic, injury and health characteristics, and resilience scores, for individuals with SCI/D. We conducted a multivariate block-design linear regression to examine factors associated with ability to perform self-care behaviors.

Results: Level of injury ($\beta=7.74$, $P<0.0001$), resilience ($\beta=0.08$, $P=0.0216$), marital status ($\beta=1.75$, $P=0.0445$), and living arrangement ($\beta=4.37$, $P<0.0001$) were positively related to higher self-care behaviors. Completeness of injury ($\beta=-2.79$, $P<0.0001$), age ($\beta=-0.09$, $P=0.0052$), age at injury ($\beta=-0.05$, $P=0.0129$), and number of

comorbid health conditions ($\beta = -0.72$, $P < 0.0001$) showed negative relationships with higher self-care behaviors.

Conclusion: Self-care ability is related to multiple factors, including resilience. The positive relationship between resilience and self-care suggests that greater resilience, independent of injury level/severity, may contribute to improved self-care behaviors in individuals with SCI/D. Other factors that showed a positive relationship with self-care included: younger age, living alone, paraplegic level injury, and fewer health conditions. Understanding the profile of persons with SCI/D with regard to self-care behaviors is important to the development of tailored interventions to improve self-care.

Financial Support: This work was supported by the Department of Veterans Affairs, Office of Research and Development Health Services Research and Development [RRP 13-248].

42. SCI PATIENT-REPORTED QUALITY OF LIFE RELATED TO BLADDER MANAGEMENT

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Objective: Patient-reported quality of life (QOL) with regard to neurogenic bladder (NGB) management after spinal cord injury (SCI) is poorly understood. As part of a Patient-Centered Outcomes Research Institute (PCORI) grant, engagement with patient stakeholders is a critical step in the development of the research agenda. Our aim was to identify key QOL factors related to NGB through a SCI stakeholder focus group.

Design: Facilitator-led semi-structured qualitative group discussion

Participants/methods: A four-hour SCI patient focus group meeting was conducted during the preparatory phase of a multicenter longitudinal study. Participants were recruited by urologists, physiatrists, and patient stakeholders with spinal cord injury. A facilitator-led, semi-structured qualitative group discussion about bladder management choices and QOL was conducted without clinicians present. Afterwards, the research team debriefed the participants about action items and conclusions. Qualitative analysis of the themes was conducted.

Results: Seventeen participants with SCI (3 female, 14 male) participated in the focus group. Most had paraplegia but several had tetraplegia and one was ambulatory. All had at least 2 years since their injury (range 2–50 years). The majority reported currently using clean intermittent catheterization for their bladder management but other bladder management methods were represented including urinary diversion and suprapubic catheter. Many reported their primary bladder management information sources were physicians and peers with SCI, followed by ancillary health care providers. One overarching theme regarding bladder management and QOL was the desire to have more information—i.e. education and accurate information was suggested as a way to improve NGB-related QOL. In addition, the participants requested that comprehensive information about all bladder management options be presented by clinicians.

Conclusion: This SCI patient stakeholder focus group demonstrated the need for our research group to improve information and communication with patients with SCI about NGB management options as a way to improve their NGB-related QOL. This is in contrast to clinician perception that tends to direct patients to bladder management methods with reduced NGB-related medical complications. While our focus group was biased towards highly motivated patients with SCI, themes identified from this meeting have helped guide our research and dissemination plan.

Financial Support: PCORI CER14092138

43. STAKEHOLDERS' PERCEPTIONS OF TRAVEL BARRIERS FOR PEOPLE WITH SCI

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Objectives: There is an increasing drive for travel and tourism research addressing barriers for people with disabilities. However, the existing travel literature, as well as the rehabilitation literature, does not provide sufficient empirical data on travel barriers for people with disabilities, especially people living with spinal cord injury (PwSCI). Since the majority of PwSCI use wheelchairs, the barriers they encounter when travelling are significantly different from people with other disabilities. The purpose of the study was to identify the types of barriers that prohibit PwSCI from participating more often in travel-related activities. The objective of this presentation is to explain the viewpoints of different stakeholders regarding these barriers.

Design: The study adopted a qualitative approach to understanding stakeholders' views on the barriers PwSCI encounter when traveling. Semi-structured telephone personal interviews were conducted among four different stakeholder groups.

Participants/Method: Qualitative interview data were collected from 39 individuals living with SCI, 24 caregivers and family members, 9 occupation/recreation therapists, and 11 travel agents who specialized in travel services for people with special needs. Data analysis was conducted using the constant comparative method to identify themes from the interviews.

Results: Almost all PwSCI agreed accessibility in travel-related services/facilities has improved since the passing of ADA. However, most recognized a systemic ignorance of the needs of people with disabilities, especially wheelchair users. Family members/caregivers were more focused on being advocates for PwSCI and on PwSCI not being hurt physically and/or emotionally in travel. Therapists paid more attention to the mindset of PwSCI, focusing on the use of problem-solving skills when PwSCI encountered barriers. Travel agents providing special services for PwSCI were frustrated with the struggle between their passion for helping their clients and the difficulty of making a living in their profession.

Conclusion: Although all stakeholder groups agreed on the travel barriers for PwSCI, their views of how to address those barriers diverged. Understanding the varying perspectives of these stakeholders should help health professionals, travel businesses, and policy makers to better grasp the magnitude of the issues in order to address the barriers.

Financial Support: The project is funded by Craig H. Neilsen Foundation (Project #321788).

44. SURGICAL OUTCOMES OF THE CONTINENT CATHETERIZABLE ILEAL CECOCYSTOPLASTY

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Objective: Cutaneous catheterizable channels allow for continent bladder emptying when the native urethra is compromised or inaccessible. There are many different surgical approaches to creating cutaneous catheterizable channels. Each technique has benefits as well as limitations. Continent catheterizable ileal cecocystoplasty (CCIC) is a technique that utilizes a tapered limb of ileum as a catheterizable channel, the ileocecal valve as the continence mechanism, and the cecum as a bladder augmentation. In this study, we sought to describe surgical outcomes for CCIC.

Design: Retrospective review from 2 institutions' combined database of patients who underwent CCIC.

Participants/Methods: We identified patients undergoing CCIC at the University of Minnesota and the University of Utah from 2011–2015. Exclusion criteria was <90-day follow-up after surgery. Data included patient demographics, etiology of bladder dysfunction, surgical approach utilized, and complication rates.

Results: Our study population included 70 patients. The mean age was 43.6. 22 (31%) of patients were male. The etiology of bladder dysfunction resulting in CCIC: 33 (47%) had a spinal cord injury, 3 (4%) had spina bifida, 6 (9%) had cerebral palsy, 9 (13%) had multiple sclerosis, 3 (4%) had a CVA, 8 (11%) had other neurologic etiology, 8 (11%) had non-neurologic etiology. Forty-six (67%) of patients underwent an open surgical approach, while 23 (33%) underwent a combined open and laparoscopic approach. Fifty-two (74%) of patients had a midline incision, and 18 (26%) had a Pfannenstiel incision. Forty-one (56%) of all patients had a post-operative complication within 90 days from surgery. Of these complications, 71% were Clavien Grade II, 24% Clavien

grade III and 4% Clavien grade IV. There were no Clavien grade V. At 90 days following surgery, Stomal stenosis rates were 8%. One required open revision, and the rest were managed conservatively with dilation or steroid cream. At 90 days following surgery, 87% of patients had stomal continence, 77% had urethral continence, and 72% had both. At 90 days, 1 patient had a ventral hernia, and 4 had parastomal hernia, all had midline incisions at the original surgery.

Conclusions: CCIC is a surgical approach with stomal continence and stenosis rates comparable to other catheterizable channel techniques. There are significant peri-operative risks, but the vast majority of complications were Clavien grade II.

45. TEAM APPROACH TO TREAT PATIENTS WITH PERSONALITY DISORDERS

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Introduction: Narcissistic Personality Disorder (NPD) is characterized by a pattern of grandiosity, need for admiration, and a lack of empathy, often coupled with vulnerable self-esteem, impairment in interpersonal relations, and poor insight (according to the Diagnostic Statistical Manual of Mental Disorders, edition 5). Like all personality disorders, NPD (and, more broadly, subclinical narcissistic personality features) is ego-syntonic, making treatment difficult.

Further, narcissistic personality features are often accompanied by challenging behavioral presentations (e.g. being condescending to providers, demanding special treatment) that interfere with patient care in medical settings. At present, there is a dearth of literature to suggest any effective treatment for narcissism given its ego-syntonic nature.

Methods: We collected baseline data for 7 days from three nursing shifts to characterize behavior of a patient residing in a long-term care medical rehabilitation setting. We then implemented a novel psychological intervention, drawing from Dignity Therapy and Narrative Ethics, with goals to use the patient's narrative to reprocess critical life moments and consolidate the ego, resulting in more positive self-appraisal and thus more pro-social behavior.

Results: At time of abstract submission, outcome data is being collected. Data will be analyzed and interpreted for presentation at Harvard Psychiatry Research Day Poster Session.

Discussion: We will discuss findings in the context of practical interventions in working with an individual with NPD who presents with challenging behaviors that may interfere with care. Finally, we consider the ethics of consent to treatment when patients lack insight into problematic personality features and behaviors.

46. THE ART OF SEXUALITY, NICE AND SLOW

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Objective: To revise sexuality education for men and women with SCI, and their partners, toward the goal of achieving increased patient satisfaction and engagement.

Introduction: Weaving together multiple themes (patient family education, sexuality in spinal cord injury [SCI], patient-centered care) supports sexuality program development that follows chronic disease self-management paradigms, enhances interactive content, and puts peers at the center of education processes.

Methods: 1. Determine fit of the Stanford Chronic Disease Self-Management (CDSM) model that includes blended learning and peer-directed education for inpatient rehabilitation sexuality discussions. Information and guidance delivered by "persons like me" is received as more credible and empathetic than if delivered by able-bodied professionals. 2. Understand changing paradigms of counselor/educator roles as peers help to develop and deliver patient-centered content. Sex-specific classes delivered by persons with injury increase patients' comfort levels and facilitate open discussion of sensitive psychosocial concerns related to

sexuality. 3. Conceptualize how peer-directed processes can be replicated. Peer-directed education assists with retention and engagement (Lorig, 2001, 1999).

Goals for SCI Educators: 1. Describe CDSM 'flip' classroom approach for peer-directed education. Replace the 'lecture' on sexual function after injury with problem-solving discussions to personalize intimacy and sexual experiences. Demonstrate how to apply this model during inpatient SCI rehabilitation. 2. Discuss changing educator paradigms and facilitating staff comfort with sexual discussions and practice. Emphasize the need to move away from didactic lectures and incorporate peer-directed discussions aimed to increase comfort and confidence in intimacy and sexual expression for patients, partners, and staff. Staff also must embrace turning the leading of these classes over to a non-licensed peer. 3. Have a person with SCI lead a peer-directed female sexuality class and describe differences in engagement and participation. Encourage staff to envision allowing consenting adults to practice different approaches to "having sex" and discuss success and challenges while support mechanisms are readily available. 4. Discuss replication opportunities and challenges in different settings.

Conclusion: Revising our approach to sexuality education classes has resulted in qualitative findings of greater patient engagement.

47. THE IMPACT OF SACRAL SPARING RECOVERY PATTERNS IN PERSONS WITH TRAUMATIC SPINAL CORD INJURY

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Objective: To describe the impact of sacral-sparing recovery patterns at rehabilitation discharge in persons with traumatic spinal cord injury (SCI).

Design: Retrospective analysis of International Standards for Neurological Classification of Spinal Cord Injury data collected for the national Spinal Cord Injury Model Systems database for patients enrolled from January 2011 through February 2015.

Participants: Individuals with traumatic SCI admitted to rehabilitation within 30 days of injury, initially classified as ASIA Impairment Scale (AIS) grades A–C, with full neurological examination data at discharge (N=1,738).

Results: The proportion of patients who improved AIS classification was 19.8% among the A's, 41.6% for B's, and 48.1% for C's. Of the persons with AIS A, who converted to AIS B at discharge (13.1%), over half (56%) converted based upon the presence of deep anal pressure (DAP) alone. There was no significant difference in average motor score observed between these patients who regained DAP only compared to other combinations of sensory sacral sparing. A small proportion (6.2%) of persons with AIS A converted to AIS C, and of these, 14.6% (N=6) did so based on the presence of VAC alone. These patients with VAC only, had a significant difference in lower extremity (LE) motor score change (1.8 vs 9.4 points at discharge), relative to patients who converted to AIS C and had sensory sacral sparing. Among patients initially with AIS B who improved to AIS C or D at discharge, it was uncommon to observe recovery based on a single sacral sparing component. Similarly, the majority of patients who were initially AIS C and improved to AIS D at discharge had regained all sacral components. Similar patterns were found for these changes at 1-year follow-up.

Conclusions: There is clinical relevance to the components of sacral sparing regained by discharge from inpatient rehabilitation, indicating differential patterns of neurological outcome in persons with traumatic SCI. The more sacral components recovered the greater the chance of motor recovery. The presence of DAP alone or VAC alone at discharge for sacral sparing is not associated with significant LE motor recovery.

Financial Support: NIDILRR grant #90SI5011

48. THE IMPACT OF SPINAL CORD INJURY ON WOMEN'S FERTILITY AND LACTATION

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Objective: To outline the changes in perinatal care (prenatal, pregnancy, labor and delivery) and lactation experienced by women with spinal cord injury (SCI) and discuss strategies to assist them.

Design/Method: Survey of health care professionals and evidenced-based workshop to initiate collaborate processes to address gaps in knowledge and to establish best practices. From this a booklet was designed. For lactation, a cross-sectional survey using a newly developed web-based questionnaire was utilized.

Results: Three themes evolved from the workshop on perinatal care: knowledge, access and collaboration. From this a printed and web-based pamphlet was developed to help women with the stages of pregnancy, labor and delivery. Some aspects of importance included medications, bladder and bowel function, autonomic dysreflexia, spasticity, DVT, skin integrity, mobility and equipment and the importance of a multidisciplinary labor and delivery team and emotional health throughout. A secondary outcome was the web-based posting of the breastfeeding questionnaire, of which 52 women with SCI responded. Among responders a higher percentage of women with a high level SCI reported insufficient milk production or ejection as a problem, and this was higher than reported previously in the literature.

Conclusions: There is a scarce and inconsistent research data on women's sexual and reproductive health following SCI and our work has contributed to the worldwide knowledge. We have attempted to provide more informative and user-friendly information for women with SCI and to have this factual but lighthearted accessible on the web. Of importance is the inclusion of both mental and physical aspects of perinatal care and lactation provided in a positive light.

Financial Support: Funds for the workshop and brochure was from Rick Hansen Institute grant. No funds were obtained for the lactation study.

49. THE ROLE OF WEIGHT SHIFTS IN PRESSURE ULCER PREVENTION

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Objective: The primary objective of this study was to determine whether there are differences between in-seat behavior of individuals with chronic spinal cord injury (SCI) who have a history of recurrent pressure ulcers (PrUs) compared with individuals without a history of PrUs. Another objective was to compare behavior of individuals with chronic SCI with those in their first 6 months following SCI.

Design: Cross-sectional cohort study.

Participants/methods: 28 individuals who were more than 2 years post SCI and 32 participants in their first 6 months post SCI had their wheelchairs instrumented to unobtrusively measure pressure relief and weight shift behaviors during two weeks of everyday life. The daily frequency of weight shifts (movements that unload at least one ischial tuberosity by 30% for 15 seconds) and pressure reliefs (movements that fully unload both ischial tuberosities for at least 15 seconds) were calculated relative to the time spent in the wheelchair.

Results: Study participants with chronic SCI spent 10.6 (3.0) hours per day in their wheelchairs, while those with recent injuries spent 7.1 (3.4) hours daily. Participants did not subscribe to a routine of regular movements, instead their days varied considerably. Few participants with chronic SCI performed regular pressure reliefs (such as a depression lift or push up). In fact, pressure reliefs were only performed every 2.5 hours on

average in this group, with no differences according to PrU history. Weight shifts were performed much more frequently than pressure reliefs. Individuals with chronic SCI and no history of PrUs performed more frequent weight shifts compared to individuals with a history of PrUs (2.5 (3.3) vs. 1.0 (1.6) weight shifts per hour, respectively). Individuals with recent SCI moved more frequently than those with chronic SCI, performing 1.1 (1.5) pressure reliefs and 3.3 (3.7) weight shifts per hour.

Conclusion: Functional movements that result in partial unloading of the buttocks are performed frequently throughout the day and may be helpful in preventing PrUs.

Financial Support: This work was completed as part of the Mobility RERC, which is funded by the National Institute on Disability, Independent Living, and Rehabilitation Research, grant number H133E080003. Support for this study was also provided through the US Department of Defense, grant number W81XWH-13-1-0387. Travel support and a small honorarium for Dr. Sonenblum was provided by Ride Designs.

50. THE STEP PROTOCOL IN SPINAL CORD INJURY: A FEASIBILITY STUDY

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Objective: 1. Evaluate eligibility criteria for inclusion in the STEP protocol for individuals with chronic motor incomplete spinal cord injury (SCI). 2. Evaluate STEP protocol tolerance for individuals with chronic motor incomplete SCI. 3. Evaluate potential walking benefits from completion of STEP protocol in chronic motor incomplete SCI.

Design: One-arm pilot/feasibility study.

Participants/methods: A convenience sample of 14 individuals with chronic (> 1 year) motor incomplete SCI walking < than 0.8 m/s were recruited from the outpatient physical therapy and community fitness/wellness programs at Craig Hospital. Individuals completed a 12-week protocol with a frequency of 3 times/week of step ergometry training augmented with functional electrical stimulation followed by 30 minutes of over ground walking training. Walking outcomes were assessed pre and post the 12-week intervention.

Results: Ten out of the 14 enrolled individuals were able to complete the study (71%). All ten subjects demonstrated improvements in walking speed and endurance with 5/10 reaching MCIDs for speed and endurance. All 10 subjects were able to decrease TUG time. Relatively high drop out rate due to intensity of training and years of chronicity as well as age may be factors influencing withdraw from study. Two adverse events noted with individuals who were > 15 years post injury.

Conclusion: The STEP protocol consisting of 12 weeks of training 3 times/week (1.5-hour sessions) was reasonably well tolerated in individuals with chronic motor incomplete SCI < 10 years post injury. All individuals completing the STEP protocol demonstrated improvements in walking function and about half of them met or exceeded MCIDs for walking speed and endurance. Subjects also reported mobility improvements not specific to walking.

Financial Support: The Kettering Foundation supported this pilot study.

51. THIRTY-YEAR CHANGES IN HEALTH AND WELL-BEING AFTER SCI

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Objective: Identify longitudinal changes in health, life satisfaction, employment, problems, and quality-of-life outcomes after spinal cord injury (SCI) among 2 cohorts totaling 104 participants. This is a detailed analysis of a subset of data that were summarized as a component of the Essie Morgan lecture at the 2015 annual ASCIP conference.

Design: Longitudinal.

Participants/methods: We enrolled 2 cohorts of participants with SCI and collected outcome measures at 5-year intervals using mail-in self-report assessments. The first cohort in 1973–1974 (n=49) and the second in 1985 (n=55) were followed until 2013–2015. Data is nearly complete for each of the 104 participants.

Results: There was a mixed pattern of stability and change, with both improvements and declines noted. The greatest changes were noted in the percentage having 10+ doctor's visits. This remained relatively low for two decades before doubling at 25 years and again doubling at 30 years. The sharp increase in the portion of individuals with 10+ physician visits were substantially greater for the older cohort, but the trend for the second cohort appeared to be in the same direction. Percent employed exceeded 60% through the first 20 years, then declined sharply after 25 and 30 years. Satisfaction with employment, finances, and life opportunities remained relatively unchanged, whereas other areas such as general health, social life, emotional adjustment, and control over life declined over time. Problems with pain, depression, and dependence increased, whereas problems with income and family remained minimal over time.

Conclusion: Long-term survivors with SCI face significant challenges. The understanding of longitudinal factors associated with aging and temporal trends may mitigate risk factors for those with a SCI. Patterns suggest 20 years of relative stability and then declines in some areas like medical care, both hospitalizations and doctor visits, and general health. As some trends are an expected result of natural aging, they may be more profound in the SCI population.

Financial Support: The contents of this presentation were developed under grants from the US Department of Health and Human Services Administration for Community Living, NIDILRR grant numbers 90RT5003 (NIDRR # H133B090005) and 90IF0015 (NIDRR # H133G110157). However, those contents do not necessarily represent the policy of the Department of Health and Human Services, and you should not assume endorsement by the Federal Government.

52. TOWARDS IMPROVING RELIABILITY OF TRANSCRANIAL MAGNETIC STIMULATION (TMS) METRICS IN INDIVIDUALS WITH SPINAL CORD INJURY (SCI)

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Objective: To understand factors which contribute to variability of transcranial magnetic stimulation (TMS) in spinal cord injury (SCI) in order to improve clinical studies that use TMS to longitudinally assess functional recovery.

Design: Longitudinal variability analysis in individuals with SCI.

Participants and Methods: Eight male patients with chronic incomplete SCI (iSCI) (53.5 ± 4.1) were enrolled. We collected TMS metrics of corticospinal excitability, output, inhibition and motor maps in muscles more and less affected by the injury. We also evaluated metrics denoting upper limb function. All metrics were collected at two sessions separated by a minimum of two weeks. The variability between sessions was then determined using spearman's and concordance correlation coefficients (SCC / CCC).

Results: We found that TMS metrics that were acquired in muscles less affected by the injury were approximately two times more reliable than those collected in muscles that were more affected (60% vs 120%). In addition, TMS metrics in muscles less affected by the injury were comparable with reliability observed in functional outcome measures (SCC=0.883, CCC=0.906). Correlation analysis indicated that patients with more baseline impairment and/or those in a more chronic phase of iSCI demonstrated greater variability of metrics ($\rho = -0.821$, $P=0.02$).

Conclusion: The ability to quantify neurologic recovery within SCI therapies still remains challenging. To offer a more comprehensive view of neurologic recovery, there has been a recent drive to introduce tools that can supplement clinical diagnosis with assessment of neurophysiology in patients with SCI. One promising

experimental technique is TMS. However, before this promising *experimental* technique can be translated into a *clinical* modality for SCI, it is critical to understand the reliability of TMS metrics in comparison to the reliability of commonly used clinical outcome measures. Here, we have found that muscles less affected by injury show better reliability in TMS metrics. In addition, our results suggest that variability is influenced by factors such as baseline impairment and disease chronicity, wherein patients who were weaker and many months post-injury exhibited greatest variability of TMS metrics. Based on our observations, TMS metrics captured in muscles less affected post-injury could act as reliable measures when assessing longitudinal functional recovery in SCI.

Financial Support: This work was funded by DoD W81XWH1110707 to EBP and FF.

53. TRANSCRANIAL DIRECT CURRENT STIMULATION WITH MASSED PRACTICE TO ALLEVIATE MALADAPTIVE PLASTICITY

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Objective: To determine if transcranial direct current stimulation (tDCS) paired with massed practice rehabilitation of the paretic upper limbs can alleviate maladaptive plasticity in patients with cervical incomplete spinal cord injury (iSCI).

Design: Randomized, sham-controlled, double-blinded clinical trial.

Participants and Methods: Eight male patients with chronic iSCI (53.5 ± 4.1) were enrolled. Patients were randomly assigned to receive rehabilitation paired with tDCS or rehabilitation paired with sham stimulation for 5 days/week for 2 weeks. From pretest to posttest, we assessed the change in features of cortical representations devoted to both muscles caudal and rostral to the lesion (less and more affected) using transcranial magnetic stimulation (TMS). Functional measures included upper extremity motor score, action research arm test, manual muscle testing and nine-hole peg test. A linear mixed methods model was used for analysis, where significance was defined as $P < 0.05$.

Results: We found that tDCS plus rehabilitation, in comparison to sham, alleviated maladaptive plasticity in the brain of our investigated muscles. Specifically, patients in the tDCS+rehabilitation group: (1) displayed a significant reduction in the cortical representation size of the less affected (stronger) muscle (by 70%), (2) had a significant medial shift of the representation of the stronger muscle (~ 10 mm, $P < 0.05$), (3) had reduced overlap between the stronger and weaker muscles and (4) demonstrated a significant focal increase in the representation of the weaker muscle (by 60%). Plasticity changes for both groups were associated with gains in motor function, with the tDCS group demonstrating a slight advantage that was sustained for three months following the study.

Conclusion: Following iSCI, maladaptive plasticity occurs in the brain. Specifically, the motor cortex begins to lose representations of weaker muscles while those of stronger, more spared magnify. Here, we have found that tDCS paired with massed practice can alleviate maladaptive plasticity and help restore the representation of paralyzed/weak muscles. While incorporation of tDCS in rehabilitation only resulted in trending increases in functional outcomes in comparison to sham initially, our findings of a sustained advantage at three months suggest that long-term pairing with tDCS may result in significant improvements in functional outcomes while continuing to alleviate maladaptive plasticity.

Financial Support: Work was funded by DoD W81XWH1110707 to E.B.P. and F.F.

54. TRENDS IN ADMINISTRATION AND PERFORMANCE ON THE SCI MEDICINE CERTIFICATION EXAMINATION

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Objectives: Examine administration and performance on the Spinal Cord Injury Medicine (SCIM) Certification Examination from 2005–2014.

Design: Retrospective analysis of data from the American Board of Physical Medicine and Rehabilitation (ABPMR)

Methods: We analyzed de-identified data from ABPMR regarding different aspects of SCIM examination administration and performance. We examined the numbers and characteristics of candidates taking the SCIM exam, candidate feedback about their perception of the exam, and candidate performance on the exam over the 10-year study period.

Results: Since 2005, candidates for the SCIM exam include those taking it for maintenance of certification (MOC) in addition to those taking the exam for initial certification. Practice track eligibility requirements for first-time exam takers expired in 2007, after 2007 first-time exam takers are required to have completed an ACGME-accredited SCI fellowship. Five hundred sixty-six candidates took the SCIM exam from 2005–2014. Of these, 131 (23%) took the exam for initial certification after completing an ACGME-accredited SCI fellowship, 73 (13%) took the exam for initial certification in the practice track, and 362 (64%) as candidates for maintenance of certification (MOC) in SCIM. Candidate perception of the exam was positive overall, 94% Strongly Agreed or Agreed that the exam was relevant to the field, and 82% that it was a good test of their knowledge. Pass rate was 83% overall, it was higher for fellowship candidates (92%) than for practice track (82%) or MOC (87%) candidates, and significantly higher for those with PM&R primary certification (89%) than those with other Board certifications (73%). A similar trend was noted for mean scaled scores. Performance by item class demonstrated that item difficulty was in a fairly narrow range by item class, with mean scaled scores ranging from a low of 6.2 (for “Pulmonary” items) to 6.8. Fellowship candidates who took the exam in the first year following fellowship completion performed better, on average, than those waiting one or more years after fellowship to take the exam.

Conclusion: The report can inform future and prospective candidates for the SCIM exam as well as those guiding them. It may also provide useful information for future exam development.

55. TWO PATIENTS WITH TRANSITION NEEDS: A CASE STUDY

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Objective: To describe the role the rehabilitation nurses in the outpatient spinal cord injury clinic played in transitioning two young men with new onset traumatic spinal cord injury (SCI) from acute adolescent inpatient rehabilitation to outpatient services and home. One patient transitioned to home and adult services within the clinic and the second patient transitioned to home and outpatient services out of state.

Design: Case study.

Participants/methods: RNs employed by the International Center for Spinal Cord Injury (ICSCI) at Kennedy Krieger Institute (KKI) in Baltimore, Maryland.

Results: The ICSCI outpatient center at KKI, Baltimore, MD, provides specialized care for persons with acute and chronic SCI, including but not limited to trauma, Transverse Myelitis, Multiple Sclerosis, Spina Bifida, and Neuromyelitis Optica. The patient population ranges in age from a few months to 86 years of age. The rehabilitation nurses assess patients, administer treatment, provide counseling, and teach patients and caregivers principles of health maintenance and illness prevention. The current case study describes the rehabilitation nurses' role in assisting two young men with newly acquired traumatic SCI through their journey along the continuum of life from adolescent to adult, as well as the continuum of rehabilitation, which includes acute rehabilitation to outpatient services and home. One young man was a 20-year-old male who sustained multiple gunshot wounds resulting in a C7 AIS A tetraplegic injury. The second case involved a 19-year-old male, who was a college freshman “horsing around” and wrestling with his friend, when he was flipped and landed on his neck. He sustained a C5 AIS B tetraplegic injury and right vertebral artery occlusion resulting in a cerebral stroke causing difficulty with

memory and executive function. Individuals with SCI develop many secondary health conditions related to paralysis, including but not limited to: skin breakdown, urinary and bowel issues, autonomic dysreflexia, and spasticity. These two young men had challenges with these conditions at different times during their journey with us. This presentation will compare and contrast their journeys through the continuum.

Conclusion: During activity-based restorative therapy, the rehabilitation nurse facilitates early assessment, intervention, and patient education to prevent loss of therapy time and further deterioration of health, which ultimately leads to the patient functioning at their maximum potential.

56. USE OF A MEDICAL/NUTRITIONAL NARRATIVE TO DISCERN MICRONUTRIENT DEFICIT

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Objective: To report a case of Vitamin D,25-Hydroxy (V-D25-OH) deficiency recalcitrant to oral Cholecalciferol (V-D3) and Ergocalciferol (V-D2) replacement, in a Veteran with Spinal Cord Injury (SCI) complicated by ulcerative colitis, mucinous Stage II cancer status post laparoscopic proctocolectomy and long term-diarrhea managed with Colestipol.

Design: Case study.

Participants/methods: A 65-year-old male presented with history of L1 AIS D SCI secondary to cord compression from hemangioma in 2009. When deficient serum concentration of V-D25OH was recalcitrant to oral V-D3 at 2,000 IU daily ongoing since 2014 and 6 months oral V-D2 at 50,000 IU weekly, other V-D3/V-D2 malabsorptive factors were screened.

Results: The Veteran's medical/nutritional narrative revealed chronological insults to adequate nutrient status including: (1) Depleted nutrient stores (28.5 # weight/WT loss prior to colectomy), (2) Compromised absorptive function (Ulcerative Colitis/Colectomy), (3) Deleterious Drug–Nutrient interactions (Prednisone prior to colectomy / Colestipol for bile acid malabsorption post colectomy), (4) Colestipol use meal time blocking a positive Nutrient–Nutrient interaction when V-D3 is taken with dietary fat. Given a strong case for fatty-acid malabsorption, serum Vitamin A (V-A), Vitamin E (V-E) and Vitamin K (V-K) were determined. Light protected/fasting AM blood samples were analyzed by High Pressure Liquid Chromatography (Lab Corp, Burlington NC), confirming V-D25-OH deficiency 15.5 ng/ml (Range/R 30–100) and elucidating-K (Phylloquinone) <0.13 ng/ml (R 0.28–1.78) deficiency. Serum deficits were seen in Vitamin A/Retinol 21 µg/dl (R-18–77) and Vitamin E/Alpha-Tocopherol 6.2 mg/L (R 4.6–17.8).

Conclusion: This case-specific medical/nutritional narrative reveals chronological influences that inadequate nutrient intake with WT loss and malabsorption from ulcerative colitis, negative Drug–Nutrient interactions and block of a positive Nutrient–Nutrient interaction can contribute to altered micronutrient biochemistry. It may behoove the clinician to evaluate other fat soluble vitamins, when V-D25-OH deficiency is not responsive to replacement therapy and fat malabsorption is suspected. Whether 25-OH-D3 deficiency in SCI could be a marker for V-A, V-K, V-E malabsorption warrants additional research.

57. WHAT DETERMINES LOW SATISFACTION WITH LIFE IN PERSONS WITH SCI/D?

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Objective: Important influences of satisfaction with life (SWL) include social relationships, independent performance in roles and goals, and satisfaction with leisure or spiritual life. Persons with a spinal cord injury/disorder (SCI/D) may experience low SWL due to: health conditions/symptoms, hampered independence, sense of grief or loss after injury, and lack of social support. The study objective was to examine variables independently associated with SWL in persons with SCI/D.

Design: Cross-sectional national survey.

Participants/methods: A survey was conducted with a random sample of community-dwelling Veterans with SCI/D who had used VA healthcare in the prior year (2014). The survey assessed demographic and injury characteristics, chronic conditions (obesity, diabetes, heart problems, lung problems, hypertension, high cholesterol), symptoms (poor sleep, pain, depression), SWL (Diener scale), social support (mMOS-SS), grief/loss, and independence. Multivariate logistic regression was used to assess factors independently associated with low SWL (<20) [reference: average/high SWL 21–35], covariates: demographic and injury characteristics, chronic conditions, symptoms, social support, independence, and grief/loss due to injury.

Results: A total of 896 veterans with SCI/D responded (62% response rate). Average age was 63 years, the majority were male (94%), Caucasian (72%), had education beyond high school (72%), and had a paraplegic level of injury (62%). Controlling for demographic and injury characteristics, chronic conditions, symptoms, independence, social support, and feelings of grief/loss due to injury, multivariate regression showed lesser odds of low SWL with higher of social support (OR=0.98, P=0.0001) and better perceptions of independence (OR=0.92, P<0.0001). Odds of low SWL were 2 times higher with pain symptoms and 1.2 times higher with feelings of grief/loss due to injury.

Conclusion: Chronic conditions did not impact SWL, but pain was associated with low SWL. Self-perceived independence and good social support were associated with better SWL, and feelings of grief/loss due to injury were associated with low SWL. Along with addressing symptoms, e.g. pain, and facilitating independence and social support, interventions to improve SWL should help individuals deal with feelings of loss due to injury.

Financial Support: Department of Veterans Affairs, Office of Research and Development Health Services Research and Development [RRP 13-248].

58. ANTHONY DIMARCO LECTURE: The Respiratory Function in Persons with Spinal Cord Injury: Where We Have Been and Where We Would Like to Go in the 21st Century

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Respiratory complications are a leading cause of morbidity and mortality in the spinal cord injured population. Our understanding of airway dynamics in persons with spinal cord injury has markedly increased over the past 25 years. With regard to the obstructive component of respiration, advances have been made in our knowledge of airway caliber, bronchial provocation, and bronchodilator responsiveness. These obstructive findings are presumed to be the consequence of unopposed, relatively increased cholinergic tone of the airway. With regard to the restrictive component of respiration, loss of function of the major chest wall muscles of respiration results in diminished lung volumes with higher levels of injury and is associated with a unique pattern of respiratory impairment characterized by a greater compromise of the expiratory than inspiratory muscle function, leading to a reduction in expiratory reserve volume and an elevation in residual volume. Paralysis of the expiratory musculature is also responsible for weak cough effectiveness, poor pulmonary clearance of secretions, and a predisposition to atelectasis and, possibly, pneumonia. The obstructive airway physiology in individuals with spinal cord injury has obvious mechanical similarities to that of asthma. Fairly recently, an inflammatory component of the airway hyperreactivity in those with higher cord lesions has been recognized, but it appears to consist of a pattern of inflammatory mediators that is distinct from that observed in asthmatics. Respiratory symptoms

occur frequently in those with spinal cord injury, with higher cord lesions often reporting breathlessness, but other symptoms of chronic cough, phlegm and wheeze frequently reported. Treatment of the higher cord lesions with bronchodilators is effective in improving airway dynamics but whether they are efficacious in preventing pulmonary complications has not yet been addressed. β_2 agonists have well recognized general anabolic properties, and these agents may strengthen chest wall muscles of respiration in those with spinal cord injury, with assumed benefit. Resistance training devices also hold promise to strengthen muscles of respiration, either apart from or in conjunction with the administration of β_2 agonists. Undeniably relevant clinical advances have been made over the past few decades in our understanding of pulmonary physiology and approaches to improve respiratory function, but these experimental strategies have yet to be shown to improve the health and wellbeing of persons with spinal cord injury in large, randomized clinical trials.